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METEOROLOGY.—*Pehr Kalm's meteorological observations in North America.* Translated and edited by ESTHER LOUISE LARSEN.[1] (Communicated by Paul H. Oehser.)

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Pehr Kalm, the first trained scientist to visit North America, arrived in Philadelphia in September 1748 for a 2½-year visit. A student of Linnaeus, his mission was to search for plants of sufficient economic significance to merit their introduction into Sweden and Finland and to supply scientific information and specimens to Linnaeus and fellow members of the Royal Swedish Academy of Science. Kalm, with his scientific training, wide interests, and natural curiosity, left for posterity records not only of the natural phenomena that he observed but also a detailed account of the cultural history of the period. His journal, *En Resa till Norra America* (A Journey to North America), published in three volumes in Stockholm, 1753–1761, is invaluable to the student of colonial history, because it includes details which the chronicler of the familiar scene tends to omit.

Linnaeus, judging the climate of like latitudes in North America to be the same as those in Sweden, was insistent that Kalm explore the region of Hudson's Bay. Surely here plants would be found that would make agriculture possible in Lapland! Linnaeus had no conception of the inaccessibility of northern Canada. Kalm did travel 12 Swedish miles north of Quebec and was convinced that the vegetation beyond that point held nothing of economic consequence.

Anders Celsius, professor of astronomy at Uppsala, had given Kalm an excellent background in astronomy. His meteorological observations for Pennsylvania, made with the aid of the centigrade thermometer invented by his former professor, were published in his journal. However, Kalm's reaction to the climate of the new world is best described in his letter for October 14, 1748, which was published in Kongl. Svenska Vetenskaps Academiens Handlingar **10:** 70–75. 1749. He says:

> Various members of the Royal Society asked me to investigate why plants, which come from America, bloom so late in Europe that their seeds seldom ripen. This is true in Sweden; it is also the case in London. The cause of all this is a difference in weather conditions. The heat here is usually dreadful during the summer and lasts further into autumn. The months of September and October are neither hot nor cold and tend to be the loveliest of the year. In reference to heat, September resembles most closely the month of July in Sweden and October the month of August. There are seldom cloudy days. The winds are rarely strong. The weather is usually calm or the breeze mild. These are generally considered the most pleasent of the year. . . . This is a remarkable place so far as weather is concerned. When the wind is from the south or the weather is calm, it is like summer until late autumn. If, however, the wind turns to the northwest and blows from the Hudson Strait where there is always ice, it becomes so cold in a few hours that one can scarcely go out, and the cold penetrates to the marrow of the bone.[2]

The results of Kalm's scientific observations are published in a series of articles that appeared in Kongl. Svenska Vetenskaps Academiens Handlingar from 1749 to 1778. In them he discusses agriculture, animals, insects, and the economic value of

[1] With the support of a grant from the American Philosophical Society.

[2] *Pehr Kalm's observations on the natural history and climate of Pennsylvania.* Excerpts from his letter of October 14, 1748. Agricultural History **17:** 174. 1943.

trees, shrubs, and herbs, together with their characteristics and medicinal uses. Two of the papers in this series are of interest to meteorology. *Några Nordsken observerade i Norra America* was published in Kongl. Svenska Vetenskaps Academiens Handlingar **13:** 145–155. 1752. It is part I of this article and is here translated under the title *Some observations on northern lights in North America.* In this paper Kalm speculates on the origin of this phenomenon and its meteorological significance. *Thermometric Rön vid Hafs och Sjöars Vatten* was published in the Handlingar **32:** 52–59. 1771. It is part II of this article and is here translated under the title *Thermometric observations on sea and lake water.*

I

SOME OBSERVATIONS ON NORTHERN LIGHTS IN NORTH AMERICA

The northern lights, or the so-called aurora borealis, have received considerable attention from naturalists during recent years. Among them various ideas are current on the subject. Some think the phenomenon has its origin in the exhalation of our lower air; others feel it originates above our atmosphere; while still another group consider it electricity.

In the natural sciences, the interpretation of these phenomena is dependent on observation and investigation. Without them a physicist gropes in the dark.

European naturalists have diligently observed and recorded the northern lights, but few Americans are interested. Observations on the northern lights in America are given in a few places in the English Philosophical Transactions. However, it should be noted that the explorers, who have been sent out recently by the English Government to find a new passage to the East Indies by way of Hudson's Bay, have recorded the northern lights they observed in their published journals.

During my stay in North America I not only kept weather reports but also recorded the northern lights which I observed and supplied myself with the reports of others. These reports were obtained from the following sources: 1. *The Pennsylvania Gazette,* which is published weekly in Philadelphia. 2. Mr. Breintnal's observations which were communicated to me by the learned Mr. Franklin. Mr. Breintnal, an assiduous observer, kept meteorological records at Philadelphia covering the period of 1731 through November 11, 1745. On that date, the mental anguish which he endured because of unchristian treatment got the upper hand and he departed this life too hastily and too pitiably. His records contain much useful information not included in other meteorological observations. 3. Dr. Colden, New York's elder statesman, who is also an outstanding mathematician and physician, supplied some information. 4. Mr. Gauthier[3], a physician well versed in botany, made extensive and accurate observations in meteorology.* He gave me his journal which covers a period of two years. I plan to turn the original over to Kongl. Svenska Vetenskaps Academien.

Most of these observations on the northern lights are entirely unknown in Europe, and some of them are in manuscripts which might easily be lost. Therefore, it seems to me that I would be doing the natural sciences a service if I presented part of the information. Some light might be thrown on the cause of this phenomenon when the observations made in America are compared with those which have been made in Europe. We have quite an impressive collection of observations on the northern lights in America if we include those published in the *Philosoph. Trans.* as well as those which are recorded by the clerk of the ship *California,* Capt. Middleton, Mr. Ellis, and other voyagers to the region of Hudson's Bay. The following information is taken from the journals mentioned above or from my own records.

1730. In Philadelphia on October 22, the aurora borealis appeared toward the NE. According to information received by letter from Boston, it had also been seen there and was the largest ever observed in that locality. The same information was also given in a letter from New Hampshire. The northern lights were so bright that it was possible to read the finest print by them. At Boston they lasted from shortly after six o'clock in the evening until day break the following morning. *The Penns. Gaz.*

[3] At the time of Kalm's visit to Canada he had the good fortune to meet Jean François Gauthier (1711–1756), the royal physician at Quebec. The name Gauthier was spelled in various ways, appearing as Gautier and Gaulthier. Linnaeus honored the royal physician by naming the genus *Gaultheria* for him.

* Footnote by Kalm: "Part of Mr. Gauthier's meterological observations were published in the Transactions of the French Academy last year by H. Du Hamel."

1731. September 21. Northern lights during the night in Philadelphia. *Breintnal.*

1736. December 29. Strong northern lights appeared in Philadelphia during the evening. They were brighter and redder than those which had been observed years before. At first, a number of inhabitants in the southern part of the city thought that there was a fire in the northern part and they hastened to help put it out. *Penns. Gaz.* Mr. Breintnal mentioned this in a letter to Collinson. It was published in the *Phil. Trans.* n. 456. p. 359. In the same letter, Breintnal says that the remarkable aurora borealis which appeared over most of Europe in December of 1737, was not observed by anyone in America.

1737. August 11. In Rhode Island, New York, Philadelphia, and elsewhere, large northern lights appeared which lasted from shortly after dark in the evening until the following morning. They extended from the NW to NE. Both ends were quite red, but the west end was redder than the east. At three in the morning they covered half of the northern horizon forming a large white arc. The upper part of the arc gave rise to innumerable rays which reached 60° in height. These rays varied from pure white to a mixture of red and white. Their appearance changed constantly like fire which blazes brightly and then glows faintly. Dr. Colden, *The Penns. Gaz.* Breintnal.

1739. March 29. In Philadelphia, the aurora borealis appeared shortly after ten in the evening. It was centered below the north star. Breintnal.

May 22. In Philadelphia at nine in the evening a bright light appeared in the north. Later, at some distance above the horizon and in the same general direction, clouds arose which were quite red. When they vanished an aurora borealis appeared on the horizon which lasted half an hour. Breintnal. *The Penns. Gaz.*

September 12. The aurora borealis was seen shortly after seven o'clock in the evening at Philadelphia. It was red in color with some white rays and in height it reached a little beyond the north star. Breintnal.

1741. March 26. Between seven and eight o'clock in the evening the northern lights were observed in Philadelphia. Breintnal.

1746. February 22. Brilliant northern lights were seen in Philadelphia. *The Penns. Gaz.*

March 1. Conspicuous northern lights appeared to the NW and NE at Quebec, Canada. Mr. Gauthier.

June 1. Extraordinary northern lights were observed in a clear sky. The northern horizon was spanned by a large pink arc which pointed toward the south but extended its rays east and west. Perpendicular light rays were given off. The display lasted until midnight when it disappeared. According to Mr. Gauthier the aurora borealis is often seen in the spring in Canada. It usually covers the NW, NE, and N part of the sky.

1748. December 9. I saw red streaks in the sky in the north at six in the evening at Racoon. This village lies four Swedish miles SEE of Philadelphia.

1749. February 4. At eight o'clock in the evening, northern lights appeared on the horizon in the north. They disappeared within a half an hour.

July 10. I saw northern lights in the sky at 10:30 in the evening at Fort Jean, Canada. Several short white rays stood next to each other, like the pipes of an organ. There were also northern lights in the area which lies between the north star and Cassiopeia. A long ray which had its origin on the NW horizon touched Charles's Wain in the south. Later, a few rays arose paralleling those on the north horizon. Practically without motion they disappeared.

1750. February 16. At a quarter of eight in the evening, I saw two meteors in the sky at Philadelphia. One, a northern light, which paralleled the horizon at a height of 20°, extended from NW to NE. I saw no color or motion. It was as light and clear as daybreak in fair weather. The other was a blood red pyramid which extended upward in the WNW part of the horizon to a point just above Cassiopeia. It now stood in an approximately horizontal line with the north star and Charles's Wain. Cassiopeia formed the apex of the pyramid. It was broader and redder below but contracted above into a sharp apex which disappeared directly above Cassiopeia. Rays and waves arose from the white light. The sky was clear and cloudless. There was an inch of snow on the ground and the air was extremely cold. Although I watched the compass carefully during the entire period that the northern lights lasted, I could not detect the slightest movement or vibration. It is quite possible that the needle of the compass was not sensitive enough for such observations. A falling star fell from SW to NE. The northern lights lasted until 10 o'clock, when they vanished. I later learned from New York newspapers that

the same observations had been made there at exactly the same time. This phenomenon is attributed to electricity by some who aspire to the title of philosopher. They claim to have predicted the occurrence of northern lights days in advance by studying the shape and action of clouds. However, I fear they have not yet perfected their art since their predictions for a later date were a month off.

April 3. In Philadelphia at 9:50 in the evening a light appeared on the horizon in the north. Within 54 minutes the sky became red to the height of 80° to the N and NNW. By 10 o'clock the sky was red entirely to the zenith from NE to NW. At 10:05 the sky became red toward the east, and the redness lessened somewhat in the NW. At 10:15, the red grew faint and the light became stronger in the north producing a pale red glow which eventually disappeared.

April 19. Late in the evening quite large northern lights appeared. The sky was so light in the north that I could read in a book. Except for a few thin clouds in the north, the sky was clear and the stars bright. The light extended from NW to ENE. The arc, most of which was over 42° in height, was quite faint near the horizon. Red was seen in the sky in the N, W, and even in the E, but it was very faint. At half past 11, a large spot appeared at the height of about 22° in the sky to the WNW. A little later another appeared at the height of 30° in the NE. Both of these spots remained for some time, and they were much brighter than the other lights. Waves of light were seen passing through the air from the spot in the NE to the one in the WNW. These waves were very weak. The spots disappeared at 11:33. However, during their existence the northern part of the sky was conspicuously lighted to a height of 30°. At 11:34 the spot in the WNW reappeared at its original position of 22° height. The spot disappeared at 11:36. The red color in the WNW grew stronger at 11:42. The sky, then as before, was very light in the north, but the brighter-colored lights had moved WNW. At 11:43 the large spot in the WNW, previously mentioned, moved NW and became quite red. Another large spot, much paler than the one just mentioned, appeared in the sky in the W. The red in the east was still evident. The center of the largest spot in the NW was at 18° height. The red spot, which now stood at 39° in the east, seemed to go directly across the sky toward the one standing opposite in the west, although they could not meet in the zenith. At 11:57 the red spot in the east began to disappear, and the one in the west was so faint it could scarcely be seen, but the red glow remaining was very faint. At 12:15 there was a pale red glow in the sky in NNE which extended almost to the north star. At 12:20 it was still light near the horizon, but the red color had disappeared. Shortly thereafter all signs of the northern lights had vanished. On this night the moon rose at 2:06 in the morning.

Oldsters could remember no other winter when there had been so many displays of northern lights. The months of April and May in 1750 were reported to be the windiest in years. However, I do not believe that there is any relation between northern lights and bad weather.

Another atmospheric phenomenon, which resembles the northern lights, is sometimes seen in the region formerly known as New Sweden. At night when the sky is overcast, a red light appears near the horizon. At that point the glow gives the effect of a burning building. The Swedes in this locality call it *Snö-eld*, or "snow fire." In the winter they consider it a sure sign of snow, and in the summer it is a sign of rain. The clouds are always in the same position when this phenomenon occurs; consequently this fire light disappears when the clouds leave. It usually appears in a SSW direction; rarely in the north, where it could readily be confused with the northern lights. At various times I have observed "snow fires". They were S, SW, or WSW except for one which was in the north and might well have been caused by the northern lights. I have found that the "snow fire" is an accurate harbinger of rain or snow. If snow does not fall where the light is first observed, it is certain to have fallen somewhere in the immediate vicinity. At Racoon on February 25, 1749, at 7 o'clock in the evening, I saw a peculiar "snow fire" just above the horizon directly to the south. It lasted until 9 o'clock, which is the longest I have ever known one to last. The entire sky was clear except for the clouds which surrounded the snow fire. When they vanished, the "snow fire" disappeared. At 8 o'clock, I observed a bright light in the horizon at the SW. I measured between the centers of these two meteors with an astrolabe arc and found them to be 52½°. The sky was entirely clear in the position of the bright light, which was quite strong and white. It remained after the "snow fire" disappeared. I have never detected the slightest movement of the needle of the compass by the "snow

fire" or the lights in the S, SW, or WSW. These lights usually follow the "snow fire". I have seen them when the sky was clear as well as when it was overcast.

June 6. A comparison of these observations, with those in the meteorological journal kept here in Sweden, shows that the northern lights here were strong on the same nights as they were seen in North America but not vice versa.

The observations that Kalm made in America on February 6 and April 3, 1750, may be compared with those made in Sweden on the same dates by referring to the Handlingar **11:** 56–58. 1750. On April 19 of the same year, we had magnificent northern lights comparable to those mentioned above. They covered the entire sky, being conspicuous toward the south. The magnetic needle was deflected 2°.

II

THERMOMETRIC OBSERVATIONS ON SEA AND LAKE WATER

During my American travels I occasionally sought to ascertain the difference between the temperature of the air and water. Since some are desirous of such information from various locations, I hereby take the opportunity to present to Kongl. Vetenskaps Academien a part of the observations I had the opportunity to make. I am fully aware of the inadequacy of these reports, especially in regard to the lack of past records. However, since complete records are lacking, we must content ourselves with those of recent years. They may throw some light on the situation but definite conclusions cannot be drawn until more is known.

My observations were made as follows: An ordinary Swedish thermometer was used, the degrees given refer to the degree above the freezing point, dates used are new style. The thermometer, when used in the open air, was always hung in the shade. When an experiment was conducted in a lake, river, or spring, the water was not dipped up in a pail or any other vessel, but the thermometer was dropped directly into the lake, river, or spring and allowed to remain for a sufficient period of time. In determining the temperature of sea water while sailing, it was necessary to take the water up in a bucket. The thermometer was then submerged more than halfway down into the water in the bucket at the moment the water was drawn up. I was not satisfied with one bucket but used a number, at least four for each test. The thermometer nearly always gave the same reading for each bucket. The sea water was from the surface and not from the depths from which I had no way of obtaining samples. Deep wells also necessitated the use of buckets. The thermometer was placed in the bucket as soon as it was drawn and several buckets were tested.

1. Observations on sea water in the ocean.

1748. August 11, in the channel directly opposite Plymouth.
12:30 p.m. The thermometer
in the open air 18½°
in sea water 18¼°
4 p.m. The thermometer
in open air 20½°
in sea water 18°

August 20, in the ocean between Europe and America.
2 p.m. at 44°30′ lat., 27° long. west of London.
The thermometer
in open air 21½°
in sea water 20½°

Later, when I took the thermometer up out of the water and held it in the air, it dropped to 19° but went up again. This shows that the air is cooler after it has touched the water since the temperature always drops a little when the thermometer is first drawn from the water.

August 22, 1:30 p.m.
Temperature of the air 23¼°
Temperature of the water 23¼°
The thermometer registered 21½° immediately after being withdrawn from the water. A sharp drop in temperature occurred if a wind was blowing when the thermometer was removed from the water.

August 28, 2 p.m. at 40° 50′ lat., 44° long. west of London.
Temperature of the air 23½°
Temperature of the water 24½°
Might not the wind which came from the north have made the air cooler than the water?

August 30, 2 p.m.
Temperature of the air 24½°
Temperature of the water 24½°

Sept. 4, noon. 40° 29′ lat., 49° 30′ long. west of London.
Temperature of the air 27½°
Temperature of the water 23½°

Sept. 4, 8 p.m.
Temperature of the air 24°
Temperature of the water 22½°

Sept. 6, was the warmest day we had during the entire voyage. 1 p.m.
Temperature of the air 28½°

Temperature of the water 27°
Sept. 10, 38° 24′ lat. at 3:30 p.m.
Temperature of the air 23¾°
Temperature of the water 23½°
1751, on the return voyage from America.
February 21, 38° 56′ lat. 2 p.m.
Temperature of the air 14°
Temperature of the water 18°
February 26, 34° 10′ lat. 10 a.m.
Temperature of the air 13½°
Temperature of the water 17°
March 3, 37° lat. 10:30 a.m.
Temperature of the air 12½°
Temperature of the water 16⅔°
March 20, 48° 58′ lat. 4 p.m.
Temperature of the air 10½°
Temperature of the water 10°

2. Observations of various kinds of fresh water,
1749, June 12, between New York and Albany at 3 p.m.
Temperature of the air 32°
Temperature of the water in the Hudson river 24°
1750, May 19, 5 p.m. The temperature of the water in a deep well was determined.
Temperature of the air 30°
Temperature of the well water 11½°
On July 4 of the same year the temperature of the water in the same well was taken at 5 p.m.
Temperature of the air 30½°
Temperature of the well water 11½°

Thus the high temperature of the air for the entire period of May and June, when temperatures were never less than 22° and often as high as 33° or 34°, had not affected the low temperature of well water. The same temperature prevailed in the water of three other deep wells investigated on this date.

A Dutchman who lives in the so-called Blue Mountains[4] between New York and Albany, had an extremely deep well. The water of this well was reputed to be the coldest in the summer of any well in the community. It was tested July 21, 1750, at 6:30 a.m. The temperature of the air was 18½° but that of the well water was 9°. For the entire previous month, the heat in this region was such that the afternoon temperature at its height varied from 28° to 32°.

[4] Apparently Kalm used the term "Blue Mountains" for all the mountains in the eastern part of the present United States. "These mountains which the English call the Blue Mountains, are of considerable height and extend in one continuous chain from north to south or from Canada to Carolina."—A. B. Benson, ed., *The America of 1750; Peter Kalm's Travels in North America* **1**: 65. New York, 1937.

August 3, 7 p.m. The temperature of the water in a brook several miles west of Albany was determined. The sun shown on the water all day. The temperature of the air was 15°, that of the brook 14½°.

August 14, 1 p.m. At Fort Oswego, the temperature of the air was 24½°. Near the shore of Lake Ontario, the water at a depth of 1 aln[5] was 25½°.

Lake Ontario is one of the five large inland lakes lying between 42° and 44° lat. Its length from east to west is about 80 French miles and its width about half that of the length. It receives all the water from the other four large lakes, Lake Superior, Michigan, Huron, and Erie, which later flows into St. Lawrence River to the sea. There are only a few small islands in Lake Ontario, and these occur near the shore. The water is clear, fresh and 60 famnar[6] deep in some places. It may prove to be both laxative and diuretic to a stranger in the region. Except for the ice along the shore, the water never freezes. A peculiarity in the lake, which I ascertained by several experiments, is an ebb and flow or a daily rise and fall, which is not associated with the moon or the hour of the day. Occasionally, if infrequently, when the water is completely calm, it suddenly becomes agitated forming large waves like those produced by a heavy storm. The air is so completely still that scarcely a leaf or feather moves. Then 2–4 hours later, the waves disappear and the water becomes almost motionless. I myself had a much too realistic proof of this in 1750, when I was returning by way of the lake from Niagara to Oswego on August 29. During a dead calm, the waves began to run heavily, although there was not the slightest sign of a wind. Had we not reached land, we could have suffered quite a misadventure.

August 18, 3 p.m. Between the Oswego and Niagara forts, the temperature of the water of Lake Ontario was taken about a mile from shore at a depth of several famnar. The temperature of the air was 25° but that of the water 22°.

August 19. Temperature readings of the water of the same lake were taken several miles nearer to Niagara. They were taken half a mile from the shore at the depth of a famn. The temperature of the air was 24°. I held the thermometer under water for one half hour and it registered 22⅔°.

[5] An *aln* is 24 to 36 inches.

[6] A *famn* equals the compass of the arms, or about 6 feet.

August 20. The temperature of the water was tested at another location in the same lake. The test was made at 5 a.m. near the shore in water half an aln deep. The thermometer registered 14° in the air but 18° in the lake. At 5:30 a.m. the temperature of the air was 14° and that of the lake water 18° at a rifle-shot distance from shore and a depth of a famn.

On a hillside between Burnets field and Albany there was a spring whose water seemed unusually cold for drinking. It was tested on September 8 at 11:30 a.m. in the year just mentioned. Part of the spring was exposed to the sun, and part of it lay in the shade. The temperature of the open air was 22°, but that of the spring was 6° as shown by several tests. To find water registering only 6° was most remarkable because the temperature of the air had for a long time prior to these tests ranged from 22° to 31° This was the coldest spring water I found in America.

1751, January 17. I again tested the temperature of the water of the same deep well in Philadelphia which I had tested on May 19 and July 4 of the previous year. At 7:30 a.m. on January 17, the temperature of the air was 7° below the freezing point, but the temperature of the water pumped from the well registered 11° to 11½° above the freezing point. The thermometer remained in the bucket during the entire time that the water was being pumped. The pumping continued until the water flooded the board covering of the well. The temperature for the entire period varied from 11° to 11½° above the freezing point. It is obvious from the foregoing that the well water in Philadelphia has nearly the same temperature for both summer and winter. However, it should be noted that the wells were very deep, and those that I tested had pumps. The wells were covered, preventing both daylight or sunlight from reaching into them.

January 28. At 7 a.m. in Philadelphia the temperature of the air was 4° above the freezing point. The temperature of the water in the Delaware River, which was full of floating ice, was tested several times, and it remained at ½° above the freezing point. At 2 p.m. the temperature of the air was 9° above the freezing point. However, the temperature of the water in the river, which still contained floating ice, remained the same as in the morning, ½° above freezing.

BIOLOGY.—*Fungus-growing ants and their fungi:* Cyphomyrmex rimosus minutus *Mayr*.

NEAL A. WEBER, Swarthmore College, Swarthmore, Pa. (Communicated by F. L. Campbell.)

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The most widespread fungus-growing ant, *Cyphomyrmex rimosus minutus* Mayr, is also one of the smallest and least conspicuous. It is the only fungus-grower generally distributed on the West Indian islands, and the species occurs with subspecific differences from the Gulf States of the United States south to Bolivia and Brazil. Wheeler (1907) described the habits of the species (as the variety *comalensis*) in Texas and its fungus as *Tyridiomyces formicarum*, a yeast belonging to the Exoaceae. The general biology in several countries has been described in a series of studies (Weber, 1941–1947). The morel-like growth on sterile nutrient agar from a pure culture of the ant's fungus was obtained in 1935 and again in 1954 (Weber, 1955). No other species is known to grow a fungus resembling this.

In the present study hitherto unknown relations with another ant and with mites are described and information given on the culture of the fungus. The field studies in south-central Florida were made possible through the assistance of Richard Archbold and the Archbold Biological Station; additional material was secured by Leonard Brass here.

HABITAT

The ant is versatile in the American Tropics and may be found in a great variety of sites where the humidity is high and temperatures uniform. The most common sites are in clay soil on the forest floor, in humus, or in vegetal debris comprising the floor litter. An empty snail shell, a curled dead leaf, a rotted twig may suffice for a colony of these small ants and they may

find requisite conditions among the roots of epiphytes or in dead wood high in the tropical rain forest canopy. Reflecting their versatility in Panamá City, Panamá, during the rainy season in July 1954 was a nest on the concrete cylinder above ground which protected a gas meter. The cylinder was 17 cm high by 36 cm in diameter and was covered loosely by a concrete cover. In the narrow space on the rim under the cover, a colony had walled off an elliptical area 36 by 17 mm and 1–2 mm high in which the entire nest with fungus-garden was formed. During dryer periods the ants would move down into the soil.

The ants show less versatility in southern Florida where the humidity and temperatures are more variable. At Key West the ants nested in porous limestone soil whose surface layer would quickly dry out. Winged males and females August 18 were clinging under a dry, flat rock while the brood and garden were kept in much deeper chambers. At Parker Islands (Highland County) the ants nested at the base of a large cabbage palm (*Sabal palmetto* (Walt.)) in a swampy area. In Highland Hammock State Park the ants nested at the base of a pine tree (*Pinus elliotti* Engelm.) in the midst of a large colony of *Wasmannia auropunctata* Roger. Both species nested between the paper-thin layers of bark at and just below soil level. During the rainy season at the Archbold Biological Station in August 1954 the ants were found nesting under wood in soil chambers, in soil about fern roots at the edge of a pool and in a rotted stump of wax myrtle (*Cerothamnus ceriferus* (L.)), all in shaded sites as in the Tropics. The rains were too intermittent to permit more widespread nesting.

THE NEST

The Florida nests were representative of those in the Tropics. The ants form irregular chambers when they do not occupy a cavity already made and these are a few millimeters in dimensions. The fungus-garden consists of the small, compact masses or bromatia stuck to the substrate. Insect excrement is commonly used and frequently the bromatia rest on pieces of insect integument that the ants bring in to the nest. The brood is kept separate from the garden in contrast to all other species, which keep the brood in the cells of the garden.

One of the Archbold Station nests was at the edge of an artificially-maintained pool among fern roots and humus in the shade. Since the roots and humus extended to water line, the site was always moist. The ants had irregular chambers in the top 2–5 cm of material and were in the midst of a large nest of *Wasmannia auropunctata* Roger. Thirty meters distant from this nest was one in the above-noted wax myrtle stump, that itself was in the midst of a thicket of palmetto and other plants. In August the ants nested slightly above and below the general ground level. This colony, too, was in the midst of a far larger *Wasmannia* nest.

ADAPTATIONS TO THE FLORIDA WINTER

Of the two fungus-growers at the Archbold Station, this species and *Trachymyrmex septentrionalis seminole* Wheeler, the latter is far more tolerant of winter coolness and dryness. During a few days visit in December 1954 the coldest weather of the winter occurred and permitted observations on winter tolerance.

At the pool margin where an active nest had existed in August, the pool water was 14° C. at 7 a.m. on December 21; lawn grass in the open was covered with frost at 0° C. The humus surface at the pool was 5.6° C. and at 100 cm in the air it was 5.2° C. These were the lowest temperatures in the December 20–26 period and daily search of the area, including superficial layers of roots and humus at the exact summer nest site, showed the *Cyphomyrmex* to be absent until the 26th. By this time the weather had gradually warmed so that by 2:10 p.m. the humus surface temperature in the shade was 22.5° C. (in the sun 24.7° C.) and the shade air temperature at 100 cm was 23.7° C. At a depth of 2.5 cm in the humus at 2:53 p.m. the temperature was 18.5° C. and at 5 cm 18.0° C. Several workers were carrying others and this would be a habit permitting a few, which had become warmed, to carry out others, thereby making possible a more general activity of the colony at the temperature threshold. The

ants went down irregular openings among the roots close to a large orange spot consisting of solidly packed *Wasmannia* workers under a dry leaf, which were also becoming warmed at the surface. One *Cyphomyrmex* worker carried a larva that was covered with the characteristic fungus of the species. It seemed that a few of the ants were moving from one site near the pool water to a more distant site.

The waxmyrtle stump appeared to contain only the large *Wasmannia* colony on December 20–26. The ants were sluggish during the cooler weather and still more adaptable than the *Cyphomyrmex* in tolerating dryer conditions of the rotted wood. None of the fungus-growers was found in deeper and adequately moist portions.

It would appear that about 18° C. is the critical lower limit of *Cyphomyrmex* activity and that even at 22° C. there is little moving about. Close to the Gulf coast at Fort Myers on December 23 several workers were found at the same shaded place as in August and the soil surface temperatures here were more generally in the 20°'s C.

BEHAVIOR OF THE ANTS

Though the workers are usually slow-moving and become immobile at the slightest disturbance, they frequently moved faster in Florida during the summer than at the usual tropical site because of the higher temperatures. The air temperature was often 30° C., to a high of about 37° C., and the soil surface also markedly warmer (30° C. and more) than they generally encountered in the tropics. Instead of moving slowly, they would, when pursued, sometimes run as rapidly as the average ant and sought to escape rather than "feign death." In "feigning death," the ants quickly curl up their legs, fold their antennae close to the head and bend their heads and gasters together so that they appear almost invisible bits of dirt when casually examined.

The ants spend much time in grooming the forelimbs and antennae and other parts of the body. Regardless of how dusty an ant may become momentarily, it keeps its antennal funiculus immaculate by drawing it through its mouthparts, with mandibles widespread, and licking and cleaning it. The comb at the base of the foretibiae is used to clean all parts of the body within reach, particularly the antennae and other legs. They also clean one another. In grooming each other the ant may carefully go over a large portion of the body. In one instance a slightly callow worker was watched as it groomed another of the same age. The one being groomed turned over on its side, like a dog or monkey would, and permitted the other to lick the entire gular surface thoroughly, the entire dorsal surfaces of the thorax and gaster, the apex of the gaster and other parts for over three minutes. The groomer kept its mandibles closed, extruding the other mouthparts, and continually played its antennal tips against the parts being cleaned. The grooming of each other and the cleaning of the brood is a significant and vital part of their activities. It removes alien bacteria and fungi and may also have a nutritive function so far as the brood is concerned.

Though the normal food of the ants consists of their bromatia, they will feed on their own damaged brood. A larva that was accidentally damaged in collecting the colony was seen to be pinched hard by the mandibles of two workers and its juices were lapped up. The mandibles could be seen meeting through the integument. Four ants were later on it, feeding intently. The integument is sufficiently tough and turgid in the healthy large larvae and pupae so that the ants would have considerable difficulty in piercing it. On another occasion the carcass of a shrivelled white pupa was seen carried that had been treated in the same manner.

The behavior of the ants with their bromatia is described under the fungus gardens.

CARE OF BROOD

The brood is kept separate from the garden and is segregated according to size; large larvae may be mingled with pupae. The brood is usually enveloped in a mycelium that differs from that in other attines in being almost granular in superficial appearance, consisting of dense masses or tufts that are always connected by ordinary

hyphal strands. Under a 32× binocular the tufts show as a more concentrated form of bromatia than in other attine species. This type of mycelium with hyphae differs markedly from the cheese-like bromatia found in the garden of these ants. About 200 tufts were estimated to be on one pupa. Eggs and the smallest larvae as well as larger brood may be covered with the mycelium. The position and frequency of the tufts indicate that they sometimes may be planted by the workers.

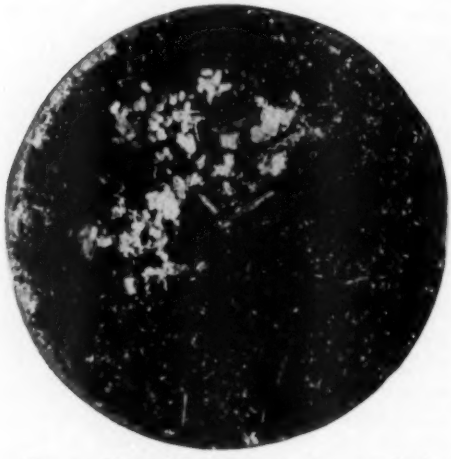

FIG. 1.—Nest of *Cyphomyrmex rimosus minutus* Mayr in a Petri dish. The brood and fungus-garden are segregated, larvae at the left, pupae at the upper center, and bromatia of the garden at the right. The brood is covered with a mycelium of different form from the bromatia but developed from them.

Larvae are fed as in other attines by placing the fungus on the mouthparts. In this species the fungus fed to the larvae seems to consist only of the cheeselike bromatia. As the larva feeds, the mouthparts go in and out like pistons while the bromatium is rasped and the juices imbibed.

CYPHOMYRMEX FUNGUS-GARDENS

The fungus-gardens consist of polygonal masses one-quarter to one-half millimeter in diameter that are termed bromatia although the bromatia of all other species are very different. Instead of aggregates of clavate hyphae (gongylidia) clustered together in varying degrees of compactness, the bromatia of *Cyphomyrmex rimosus* are solid masses of cells. They usually grow on insect feces, but carcasses of insects are commonly found in the nest with bromatia stuck to them. In feeding, an ant will pick up a bromatium, hold it between its fore feet and mandibles, rotate it with the fore tarsi while the mouthparts abrade the surface or score it, and imbibe the juices. If the mandibles are kept closed, the other mouthparts do the abrading; if they are kept open, they are used to score the surface of the bromatium. The antennal tips play over the bromatial surface continually. One ant may take a bromatium from another and commence eating without evoking hostility. During this treatment the bromatium becomes much reduced in size and glistening from its juices and the saliva of the ant. It is then placed back on the substrate, sometimes after defecating a drop of feces on it.

At times a score or more of the bromatia may be piled together in the nest away from substrate. Small bromatia may be somewhat of an opaque, dead white; larger ones are commonly pale amber or grayish with a touch of brown. In a pile the bromatia may develop a short, scanty growth of hyphae and this is particularly true of the small, pale type. This hyphal development is apparently intermediate between the bare bromatia and the tufted mycelial covering of the brood.

ARTIFICIAL FUNGUS CULTURES

Bromatia were transferred to tubes of sterile Sabouraud's dextrose agar and commonly contaminations developed which overwhelmed the ant fungus. An August 5, 1954, series of transfers, for example, developed by August 9 (at 24° C.) concentric layers of dark and light hyphae about a white center which produced an "eyed" effect; another contaminant produced a luxuriant cottony mycelium; a third developed a bacterial or yeasty slime about the bromatia. From a single bromatium transferred August 11, however, an entirely different growth developed. It was kept until August 22 at 24° C. and thereafter under variable temperatures. On August 12

it appeared to have grown, and on August 14 it had a few thin hyphae growing out on the agar surface from a definitely larger mass. By August 17 it had not only increased in size but had developed a raised base that was covered with hyphae. By August 22 the much larger mass was transferred to a flask. In the meanwhile, an August 11 transfer of a cluster of about a score of bromatia, kept under the same conditions, by August 20 had increased in number through budding and the individuals had also grown larger. By August 21 this mass had increased in height from an original 1–2 mm to 5 mm on a broad base 1 mm. thick.

Both cultures and their transfers developed during September a morel-type of fungus covered with a thin growth of short hyphae that closely resembled that which I grew in 1935 in Trinidad (Weber, 1945) from the same species of ant. This was verified as the true ant fungus as follows:

On September 13 the flat basal layer of one of the cultures was cut into two pieces and introduced into separate containers, each containing ants from a colony different from that which served as the original source for the artificial cultures. The layer was tough in consistency. These ants had been deprived of their fungus since approximately August 26 but had access to corn sugar syrup in the interval. At first the ants only occasionally investigated the cultured fungus and seemed to feed briefly, but it was not clear whether they were feeding on a film of agar or on the fungus. Five hours later it was clear that the fungus was the attraction and seven, then eight, ants were in attendance in one container, all busily engaged in cutting or attempting to cut the tough piece. This fungus had the same color and consistency as their normal bromatia. Two ants were similarly engaged with the second portion. Within two more hours the ants had cut small pieces about the size of their normal bromatia, or smaller, and had piled them in a moist situation. On following days the ants cared for these pieces as though they were their own bromatia and by September 22 consumed all in one of the containers. The experiment was then repeated with this group of ants and a third fungal mass, with similar results. The morel growth proved to be 0.43–0.49 mm thick, whether folded or lying flat. Within three hours the ants had cut much of the fungus into bromatia-size particles. Five days later the remainder and uncut fungal mass was sprouting hyphae wildly and was clearly abandoned, while the artificial bromatia were being cared for and carried about normally.

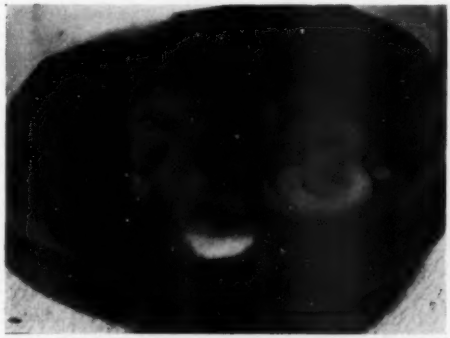

FIG. 2.—Morel-like growth from bromatia of *Cyphomyrmex rimosus minutus* Mayr developing in a flask of Sabouraud's agar. Phot. Lloyd Merritts.

During October various portions of colonies were similarly given the artificially cultured fungus with the same result. They were also given feces of wood-boring beetles which they accepted and used as substrate for the bromatia. The ants were often seen clearly to ingest the fungus as in nature. The ants were able to keep these bromatia or their successors alive for more than six months.

RELATIONS WITH WASMANNIA AUROPUNCTATA ROGER

The ranges of *Cyphomyrmex rimosus minutus* Mayr and the much smaller *Wasmannia auropunctata* Roger are comparable in the American Tropics, and both are common ants on many of the West Indian islands. The only previous record of the two being more than casually related appears to be from Venezuela (Weber, 1947, p. 145) where I found that "associated with the *Cyphomyrmex* (*C. rimosus curiopensis* Weber) was a nest of the tiny myr-

micine ant, *Wasmannia auropunctata* Roger, whose chambers must have anastomosed with those of the other ant."

Of seven nests of *Cyphomyrmex* examined in southern Florida, three were intimately associated with more populous *Wasmannia* nests and two had the latter nesting in the immediate vicinity. One of the remaining two had recently been formed under a temporarily wet piece of wood and the other nested at the base of a palm in a swampy situation where *Wasmannia* was not taken. *Wasmannia* occurred at two of the sites in December as they did in August and showed a greater tolerance to dry conditions, and perhaps cold, than did the fungus-grower.

When portions of any of these nests were gathered with adjacent *Wasmannia* chambers and placed in observation nests, there was no mass slaughter of either. Rather there was a milling about, with few of the two species meeting in combat, and a rapid reassortment of brood and ants with the two taking up separate places. Nevertheless, with the passage of time, dead ants of both species were commonly found with enough observations to suggest strongly that combats between the two were responsible. Occasionally a *Cyphomyrmex* would be seen with a dead *Wasmannia* attached to an appendage. One, for example, had the smaller ant attached to the left posterior leg and walked easily, considering the impediment. Some of the larger ants were found with all appendages intact and lying on their backs or sides. The observation below shows the effectiveness of the sting of the smaller species.

A *Wasmannia* worker that was not one-third the bulk of the *Cyphomyrmex* found a partly shriveled larva attached to the surrounding soil by a strand of tissue. It fed by licking abrasively and did not attempt to carry the larva away. Immediately one, then two other *Cyphomyrmex* came up to it, stalking like miniature rhinoceroses and walking directly up to the smaller ant. It ignored them, though hostility was indicated by their stance, and kept on feeding. A fourth *Cyphomyrmex* approached the tableau but went off. One of the larger ants finally pushed its head against the *Wasmannia*, which kept on feeding. I then saw that this ant had the common *Cyphomyrmex* type of mite attached to its gular surface and this, too, was extending its palps to the food.

The *Cyphomyrmex* with head next to the smaller ant suddenly attempted to sieze the food, whereupon the *Wasmannia* quickly curled its gaster forward and stung the other ant in the mouth. It recoiled on its back as though momentarily paralyzed, then regained its feet and went off. Close to this scene was another of the larger ants on its back, feebly waving its appendages as though paralyzed and unable to regain its feet. Other *Cyphomyrmex* in this and other nests were in similar attitudes and it is probable that these also had been stung by *Wasmannia*. Ten minutes later the *Wasmannia* was still feeding.

MITES WITH THE CYPHOMYRMEX

The common occurrence of mites with this fungus-grower in Florida is a complication that seems never to have been realized. It has not been observed to a comparable extent in any of the numerous species that I have kept under observation in Tropical America nor is it so recorded in the literature. Eidmann (1937, pp. 403–404) lists mites from *Atta sexdens* nests in Brazil but mostly as coprophiles or neutral synokoetes and never as ectoparasites or in phoresy.

All colonies taken at the Archbold Biological Station contained mites that were riding on the worker ants. Since the ants are small and the mites much smaller they were commonly recognized under the binocular microscope. In this restricted field of vision as many as seven out of sixteen ants in view at once had mites on them although commonly two or three ants out of ten might show mites. Since the mites can quickly leave their hosts and some may be hidden on underparts of the ants a complete census cannot readily be made. Frequently an ant will have more than one mite. Two mites may occupy opposite sides of the ant thorax, may face each other here or be in tandem position. One ant had two on the thorax and one on the underside of the gaster. The head and gaster are also

common sites. The mites have no difficulty in moving from one site to another on an ant and hold on tightly with body appressed and mouthparts porrect.

These mites, unfortunately not yet identified, closely resemble those taken on *Trachymyrmex septentrionalis seminole* nesting nearby and may well be the same. Two collections from the latter ant were identified as *Garmania* sp. (Phytoseiidae) by G. W. Wharton.

A transfer of a mite from one ant to another was watched under the binocular. It had been riding on the gaster of one ant when another brushed by, waving its antennae over the other ant as is customary. In a flash the mite grabbed the left antennal tip, taking a position with its head facing proximally, and held tightly. The ant did not attempt to dislodge the mite and had already two others, one on the thorax, the other on the gaster. The mite on the antenna grasped firmly with all legs and kept its palpi appressed as the ant attempted to force its way through a narrow passageway, antennae probing the meanwhile. The mite had a rough ride but was not dislodged.

A mite was watched for more than ten minutes as it fed on a bromatium. It fed from below only, "pecking" at the fungus repeatedly and clearly ingesting it. The palps played continually over it. Some mites had their short mouthparts, in addition to the lateral palpi, appressed to the integument of the ants and may have been ingesting the epidermal secretions.

ANTIBIOTIC AND GROWTH-PROMOTING ASPECTS OF THE SYMBIOSIS

This ant fungus has not been recognized outside of the nest and appears easily to be overwhelmed by other fungi in artificial culture. It is clearly maintained by the activities of the ant and is cultivated only in the form of small compact masses or bromatia. The same fungus grows regularly on the eggs, larvae and pupae in a hyphal form. In feeding on a bromatium, the ant adds its saliva to the fungus and may defecate on it before replacing it in the garden. In licking the brood, a regular feature of attine ant behavior, saliva must also be added to the integument. This may be nutritive for the mycelium, or the mycelium may digest substances from the integument. The ants keep each other immaculate by constant grooming, in which the integument is well licked. The saliva added to the integument may prevent the development of alien fungi and bacteria.

From the above review of behavioral features it would appear that distinctive antibiotic and growth-promoting features are produced in the symbiosis. A study of the roles of the ant feces and saliva is indicated.

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ENTOMOLOGY.—*Type specimens of mosquitoes in the United States National Museum: I, The genera* Armigeres, Psorophora, *and* Haemagogus (*Diptera, Culicidae*). ALAN STONE, U. S. Department of Agriculture, and KENNETH L. KNIGHT, Bureau of Medicine and Surgery, Department of the Navy[1]

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Holotype designation by mosquito taxonomists has become a standard practice only within comparatively recent times. As a result, many mosquito species are presently represented by more than one type specimen (syntypes or cotypes). Since the fixation of a specific name to a single specimen is essential to sound taxonomy, it is desirable practice in such situations for subsequent workers to designate one of the original type series as a lectotype. The mosquito collection of the United States National Museum contains many such syntype series, and it is proposed to prepare a series of papers for the purpose of designating lectotypes from them. In addition, pertinent notes will be given on some of the holotypes in the collection. The present paper deals with the genera *Armigeres*, *Psorophora*, and *Haemagogus*.

The types are stored separately from the main body of the collection, the pinned specimens being in separate trays in drawers, and the slides lying flat in metal cabinets. These are holotypes, lectotypes, or selected syntypes pending lectotype designation. They are arranged alphabetically by species, subspecies, or varietal name, regardless of their original or present generic position or specific synonymy.

In checking over the older species, particularly those of Coquillett and of Dyar and Knab, it has not always been possible to determine whether or not a holotype had been designated in the original description. Several localities may have been given, followed by the line "Type.—Cat. No. —— U.S.N.M." In the collection, sometimes only one specimen bears this type number, sometimes several or all of them. If a single specimen only is labeled as type, we accept it as the holotype, and if this is not considered a validly proposed holotype, acceptance of such a specimen as type in this paper is to be considered as lectotype designation. Where more than one specimen is labeled type, we have always selected a lectotype. Most, but not all, of the types bear catalogue numbers, and where we refer to red U.S.N.M. labels we mean labels bearing the words "Type (or "Paratype," or "Cotype") No. —— U.S.N.M."

In this paper the names are arranged alphabetically within the genera and are listed under the original generic combinations. Taxonomic notes are given only where something has been discovered that alters the present concept of the species, or are otherwise pertinent. We have placed lectotype labels on all the specimens selected as lectotypes in this paper.

Genus **Armigeres** Theobald

Desvoidea fusca var. *joloensis* Ludlow, Can. Ent. **36:** 236. 1904.

According to the original description, the series consisted of "23 (males and females)." The collection has 2 males and 3 females bearing the label "Type No. 27789, U.S.N.M.," and only these are listed in the type catalogue. One of the males bears a determination label in Ludlow's handwriting, "*Desvoidea joloensis* Ludl. Jolo Jolo, P.I. May. Type C.S.L." The other specimens bear only the red U.S.N.M. type labels. We have selected the male bearing Ludlow's label as lectotype, and have mounted the genitalia on a slide.

Culex subalbatus Coquillett, Proc. U.S. Nat. Mus. **21:** 302. 1898.

This species was described from 6 females, each spread on a card mounted on a separate pin. We consider the holotype to be the only specimen bearing the label "Type No. 3962, U.S. N.M." It also bears a determination label in Coquillett's handwriting.

[1]The opinions or assertions contained here are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large.

Genus **Psorophora** Robineau-Desvoidy

Psorophora agogglyia Dyar, Ins. Insc. Mens. **10:** 115. 1922.

The three female syntypes (Type no. 25755, U.S.N.M.) are in the collection, bearing the data "Museum Paris, Gran Chaco, bords du Rio Tapenaga, Colonie Florencia, E.-R. Wagner 1903." We have selected one of these, in excellent condition, as the lectotype.

Janthinosoma champerico Dyar and Knab, Proc. Biol. Soc. Washington **19:** 134. 1906.

This species was described from a single female labeled "Champerico, Guatemala/Fredk. Knab Collector/Type No. 9968, U.S.N.M." and bearing the determination label in Dyar's handwriting, "Janthinosoma champerico D. & K. Type." This specimen is in good condition except for the loss of segments 4 and 5 of the left hind tarsus.

Janthinosoma coffini Dyar and Knab, Proc. Biol. Soc. Washington **19:** 134. 1906.

The original "8 specimens, Nassau, Bahamas, B. W. I., June 22, 1903 (T.H. Coffin)" are in the collection. All are females and one bears the red label "Type No. 9969, U.S.N.M." and the determination label in Dyar's handwriting, "Janthinosoma coffini D. & K. Type." This specimen, which we consider the holotype, is in good condition except for the loss of three legs.

Janthinosoma columbiae Dyar and Knab, Proc. Biol. Soc. Washington **19:** 135. 1906.

Of the 59 specimens of this species originally listed ("Type.—Cat. No. 9974, U. S. Nat. Mus."), 42 are now in the collection. Only one bears the red U.S.N.M. type label. It also bears the label "Iss. IX.27 Grassym." and the determination label in Dyar's handwriting, "Janthinosoma columbiae D. & K. Type" and is a female in good condition. This is one of the Grassymead, Va., specimens and we here consider it to be the holotype.

Psorophora (*Psorophora*) *ctites* Dyar, Ins. Insc. Mens. **6:** 126. 1918.

This was described from three syntype females collected at Brownsville, Tex., August 28, 1916, by M. M. High, Type no. 21717, U.S.N.M. These are all in the collection and the one bearing the determination label "Psorophora ctites Dyar, Type" in Dyar's handwriting is here selected as lectotype.

Culex cyanescens Coquillett, Journ. New York Ent. Soc. **10:** 137. 1902.

Six females are mentioned in the original description, "Type: Cat. No. 6308, U.S.N.M."; these, each bearing a red type label, are to be found in the collection and only two are listed in the type catalogue. One specimen, dated June 4, bears a determination label in Coquillett's handwriting, but the other syntype, bearing the labels "Coll. Townsend/Brownsville, Tex./May," is in better condition and is here designated as lectotype.

Culex discolor Coquillett, Can. Ent. **35:** 256. 1903.

This species was based on a single female in good condition, bearing the labels "Delair, N. J. VI.28/Type No. 6894, U.S.N.M.".

Janthinosoma echinata Grabham, Can. Ent. **38:** 311. 1906.

The description gives no indication of the number of adults in the original series nor where the specimens were deposited. There is a female in the collection bearing the labels "Kingston, Jamaica/M. Grabham Collector/See slide No. 373/Janthinosoma echinata Gbm [Dyar's handwriting]." The slide is of the female genitalia and is labeled "Type" by Dyar. The specimen is in moderately good condition. Mr. Mattingly wrote us that there are "4 pinned adults labeled 'Kingston, Jamaica, Dr. Grabham' in the British Museum which were included by Theobald in his description of *Janthinosoma sayi* var. *jamaicensis*. That they formed part of Grabham's type series is, I should say, doubtful and certainly it could not be proved." From Dyar's correspondence with Grabham it is evident that part or all of Grabham's collection in Jamaica was destroyed by an earthquake. In the absence of any information to the contrary, we consider this female labeled by Dyar to be the holotype.

Janthinosoma floridense Dyar and Knab, Proc. Biol. Soc. Washington **19:** 135. 1906.

This species was described from 105 specimens which were entered by Dyar in the U.S. N.M. Type Catalogue as "Type and cotypes," all collected in Florida. The collection now contains 95 of these, and all bear the collector label "Dyar and Caudell" and a field number. A female bears the number "43," red label "Type No. 9972, U.S.N.M.," and the determination label in Dyar's handwriting, "Janthinosoma floridense D. & K. Type." This specimen is the

only one bearing a red type label, and we consider it to be the holotype. Dyar and Caudell's notes show no. 43 to have come from Alligator Creek, Fla.

Psorophora funiculus Dyar, Ins. Insc. Mens. **8:** 141. 1920.

This species was originally described from "Types, two males, two females, No. 23088, U. S. Nat. Mus., Río Frio, Dept. Magdalena, Colombia, March 4, 1913 (J. H. Egbert)." The collection has these syntypes with the exception noted below. The date on all of them is "3–5 March 1913." One of the males is intact and this is here designated as lectotype. The second male is lost from the pin but most of the abdomen is mounted on a slide. The two females are in good condition.

Aedes haruspicus Dyar and Knab, Proc. U. S. Nat. Mus. **35:** 56. 1908.

This species was described from "Twenty-one specimens, Port Antonio, Jamaica, bred from larvae in seaside pools, November 15, 1906 (M. Grabham)." The collection contains 8 males and 8 females of this series. One of each sex bears a red label, "Type No. 11995, U.S.N.M.," and the female, in good condition, bears the determination label in Dyar's handwriting," "Aedes haruspicus D. & K. Type." We select this female as lectotype.

Aedes horridus Dyar and Knab, Proc. U. S. Nat. Mus. **35:** 56. 1908.

The original description lists 56 specimens from a number of localities, with no sex given, followed by the line "Type.—Cat. No. 11999, U.S.N.M." The collection now contains 42 of these 56 specimens. One female bears the labels "Victoria, Texas V.30/W. E. Hinds/Type No. 11999 U.S.N.M. [red]/Aedes horridus D. & K. Type [Dyar's handwriting]." A second female from Greenville, Texas, bears the same red type label. These two specimens are designated specimens I and II respectively in the following discussion. In addition, there are 40 specimens labeled by one of us [A. S.] with red U.S.N.M. cotype labels at the time the series was being restudied.

When Roth (1945) restudied these specimens, he discovered that two species were involved. He selected as a lectotype not one of the two specimens marked with a red type label in the collection, but one of those marked "cotype" that was listed in the original description, from Corinth, Mississippi. The identity of *Psorophora horrida*, as based upon this lectotype, has become accepted in current mosquito literature in the United States. For the reasons that follow, we accept this as a validly selected lectotype and reject the specimen (No. I) labeled by Dyar as type, as the type of *horridus*.

1. Two specimens (I and II) out of the original 56 were originally labeled with identical red type labels, and these were from different localities. A lectotype designation was necessary, since these are obviously syntypes.

2. The U.S.N.M. Type Catalogue gives a number of localities and several collectors, and there is no distinction between types and cotypes or paratypes in the catalogue, these all being designated as "Types." More than just the two specimens bearing the type labels were considered as types in the catalogue.

3. Roth examined all but one of the specimens listed in our first paragraph. His opinion that two species were involved in determinations of *Psorophora horrida* was based on both female and male characters, but since only females were included in the original series he selected a female from Corinth, Miss., as the lectotype. Specimen I was not at the Museum at the time Roth studied the series, since types or selected syntypes were removed from wartime dangers.

4. Howard, Dyar, and Knab (1917) accepted Felt's (1904) description and photograph of the male genitalia of *Janthinosoma lutzii* as being of the male of *horrida*, and redrew it. Roth accepted this opinion and showed that the species having silvery white knee spots and other external characters had genitalia of this sort. The original description of *horridus* states, "the knees silvery white," in this respect not agreeing with specimen I. All the characters of specimen I agree with *P. longipalpis* Roth, while specimen II appears to be *horrida* as defined by Roth. He could have selected II as the lectotype, but apparently preferred to take a specimen from nearer the center of distribution of the species.

Psorophora howardii Coquillett, Can. Ent. **33:** 258. 1901.

The original 3 males and 1 female of this species, from Hartsville, S. C., July 23, 1901, W. K. Coker, are in the collection. One of the males, in good condition, bears the red label

"Type No. 5793, U.S.N.M." and Coquillett's determination label, and we consider it the holotype.

Janthinosoma indoctum Dyar and Knab, Proc. Biol. Soc. Washington **19:** 161. 1906.

In the original description this name was said to be proposed "for the larvae called '*Janthinosoma scholasticus* Theobald' (Journ. N. Y. Ent. Soc. xiv, 182, 1906)," but the authors described the adult and gave as material "22 specimens, Trinidad (F. W. Urich; A. Busck). Type—Cat. No. 10026, U. S. Nat. Mus." We find in the collection one male bearing this type label and the labels "17.3/Trinidad, W. I. Jan./Aug. Busck Collector." This specimen, which has associated with it a pupal skin on a slide, we consider the holotype.

In addition there are 18 other specimens (14 females, 4 males) bearing the labels "42 [some with subnumber]/Trinidad, W. I. Jun./Aug. Busck Collector." There is also one female labeled "Trinidad, W. I., F. W. Urich." These 19 specimens are presumably also of the type series but do not bear type labels. Five of the no. 42 series have associated pupal skins and some of them fragments of larval skins mounted on slides.

Janthinosoma infine Dyar and Knab, Journ. New York Ent. Soc. **14:** 181, 182. 1906.

The larva of this species is described in the key on p. 181, and additional characters are given on p. 182, and portions of the larva are figured. There is no indication of the number of specimens included nor is the adult described. Dyar and Knab state that the larvae were collected by Busck in Trinidad and Santo Domingo. The collection contains no specimen bearing a type label, but there are 19 males and 17 females collected by Busck in Santo Domingo, a number with associated larval and pupal skins. We have selected as lectotype a larval skin bearing the number 103.1. Associated with this is a pupal skin on the same slide and a pinned male in good condition but with a portion of the abdomen separately glued on the point. This male bears the labels "103.1/St. Domingo, W. I. Aug./Aug. Busck collector/See slide no. 193/infine [Dyar's handwriting]." Slide no. 193 of genitalia did not come from this specimen, however, since it has more of the abdomen on the slide than is gone from the pinned specimen, and it bears Busck no. 105. Slide no. 192 bears Busck no. 103.1 and the genitalia on this slide is with little doubt from specimen no. 103.1. Data on this slide, no. 192, are given under no. 193 in Dyar's slide catalogue.

Janthinosoma insularius Dyar and Knab, Proc. Biol. Soc. Washington **19:** 135. 1906.

This species was described from "8 specimens, Santo Domingo, W. I. (A. Busck), Type—Cat. No. 9975, U. S. Nat. Mus." These specimens, all bearing Busck no. 108, are in the collection (5 females, 3 males), and one female, which we consider the holotype, bears the red U.S.N.M. type number label and Busck's number 108.1. The specimen is in fair condition and has associated with it the larval and pupal skins on a slide.

Psorophora iracunda Dyar and Knab, Proc. Biol. Soc. Washington **19:** 133. 1906.

This species was described from "5 specimens, Puntarenas, Costa Rica (F. Knab), Type.—Cat. No. 9965, U. S. Nat. Mus." The collection now contains 4 of these, 3 females and 1 male. We consider the holotype to be a female bearing the determination label in Dyar's handwriting, "Psorophora iracunda D. & K. Type" and the U.S.N.M. red type label. The others do not bear the red type numbers. All the specimens have associated larval and pupal skins on slides, and the genitalia of the male are mounted on a slide.

Psorophora (*Janthinosoma*) *longipalpis* Roth, Proc. Ent. Soc. Washington **47:** 13. 1945.

The holotype is a male in good condition, with the entire abdomen on a slide. There are 40 paratypes.

Culex nanus Coquillett, Can. Ent. **35:** 256. 1903.

The original material consisted of "Four specimens collected at Key West, Florida, in August 1901 by Mr. August Busck and six specimens by Mr. E. A. Schwarz, April 1 to 3, 1903. Type—No. 6893, U. S. National Museum." All 10 of these female specimens are in the collection and all bear identical red type labels. We select as lectotype the one bearing Coquillett's determination label, collected August 1901. It is in rather good condition, lacking one leg and part of one wing.

Psorophora pisces Lassmann, Bol. Salub. y Asist. no. 28–29, Jalapa, Veracruz, Agosto, p. 4, 11–12. 1944.

The total number of specimens was not indi-

cated in the original description, nor was a holotype designated, but the National Museum possesses 10 females and 3 males of the original series from Tempoal, Veracruz, Mexico, July 1944. The slide of the genitalia of one male is labeled "Type" by the author, and that of another "Paratype," but these slides are not so labeled as to tell which set of genitalia came from which pinned male. It seems best, however, to select the male slide labeled type as the lectotype, leaving the rest of the specimen uncertain. There is no evidence that the series does not all represent one species, and no reason to believe that Lane (1953) was incorrect in considering *P. pisces* Lassmann to be a synonym of *P. champerico* (Dyar & Knab).

Psorophora saeva Dyar and Knab, Proc. Biol. Soc. Washington **19:** 133. 1906.

Of the three original specimens only one can be certainly recognized. This is a female, in good condition except for lacking most of three legs and the tip of one wing. It bears the red label "Type No. 9964, U.S.N.M." and the labels "Trinidad, W. I./F. W. Urich/B4-1/Psorophora D. & K. Type [Dyar's handwriting]." This we consider to be the holotype. No larval or pupal skin has been found to bear the number B4-1.

Janthinosoma schwarzi Dyar and Knab, Proc. Biol. Soc. Washington **19:** 135. 1906.

The single specimen from Cayamas, Cuba, Type no. 9970, U.S.N.M., is a female in good condition except for the loss of segments 4 and 5 of the left hind tarsus.

Taeniorhynchus signipennis Coquillett, Proc. Ent. Soc. Washington **6:** 167. 1904.

The original material of this species was stated to be from "Monterey, Mexico. One female and four males (the latter much abraded), bred by Dr. Goldberger. Type—No. 8029, U. S. National Museum." All 5 of these specimens bear identical red type labels. The female is in much better condition than the males and it bears Coquillett's determination label, so we select it as lectotype.

Psorophora stigmatephora Dyar, Ins. Insc. Mens. **10:** 116. 1922.

The types were given as "two females, and one male, No. 25756, U. S. Nat. Mus." These syntypes are in the collection, bearing red type number labels. We select as the lectotype the male bearing the labels "Museum Paris, Gran Chaco, bords du Rio Tapenaga, Colonie Florencia, E.-R. Wagner 1903/1660." This specimen lacks one wing, one antenna, one palpus, and three legs and the other wing is in poor condition. The genitalia are mounted on slide no. 1660. One female is in poor condition, the other in rather good condition.

Janthinosoma texanum Dyar and Knab, Proc. Biol. Soc. Washington **19:** 135. 1906.

The original series consisted of "7 specimens, Brownsville, Texas, May 21, 1904 (H. S. Barber). Type.—Cat. No. 9971, U. S. Nat. Mus." In the type catalogue these are listed as 5 specimens, "Type and cotypes." The collection now contains one female in good condition with the determination label and red U.S.N.M. type label, and 5 females bearing only date, locality, and collector labels. We consider the specimen labeled type to be the holotype.

Janthinosoma toltecum Dyar and Knab, Proc. Biol. Soc. Washington **19:** 135. 1906.

This species was described from 89 specimens entered by Dyar in the U.S.N.M. Type Catalogue under no. 9973, as "Type and cotypes." The collection now contains 72, all from Mexico, the Dallas, Tex., specimens collected by Hinds not having been found. The one specimen bearing the red U.S.N.M. type label, which we here consider to be the holotype, is a female in good condition from Tehuantapec, Oaxaca, Mexico. It bears the label "No. 286. See F. Knab's Entom. notes." These notes show the specimen to have been collected as a larva, June 29, 1905, from ditches of very foul water along railroad tracks. This specimen also bears the label in Dyar's handwriting "Janthinosoma toltecum D. & K. Type."

Psorophora totonaci Lassmann, Proc. Ent. Soc. Washington **53:** 285. 1951.

The holotype is an intact male in good condition except for being somewhat greasy.

Janthinosoma vanhalli Dyar and Knab, Proc. Biol. Soc. Washington **53:** 285. 1906.

This species was described from 7 specimens entered by Dyar in the U.S.N.M. Type Catalogue under no. 9967, as "Type and cotypes." All these specimens (5 females and 2 males) are in the collection, and bear the label "Paramaribo, Surinam, Dr. Van Hell." A female bearing the red U.S.N.M. type label also bears the label

"called tigri-makoe" and the determination label in Dyar's handwriting "Janthinosoma vanhalli D. & K. Type." This specimen is considered to be the holotype.

Conchyliastes varipes Coquillett, Can. Ent. **36:** 10. 1904.

The original description states "Five female specimens, Type No. 7341, U.S.N.M. Las Peñas and Tonala, Mexico (Dr. A. Dugès), and Agricultural College, Mississippi (May 18, Glenn W. Herrick)." The collection has 4 of these specimens, the Tonala specimen not having been found, and two (Mexico and Mississippi) bear identical red U.S.N.M. type labels. We select the female bearing Coquillett's determination label, from Las Peñas, Mex. 7-18-03, A. Dugès, as the lectotype. This is in fair condition except for having two legs missing.

Psorophora virescens Dyar and Knab, Proc. Biol. Soc. Washington **19:** 133. 1906.

The original description mentions 35 specimens from Mexico and Costa Rica, "Type.—Cat. No. 9966, U. S. Nat. Mus." The collection now contains 32 of these. We consider the holotype to be a female, in good condition, bearing labels "No. 309g See F. Knab's Entom. Notes/ Almoloya, Oax. Mex./Type No. 9966 U.S.N.M./ Psorophora virescens D. & K. Type [Dyar's handwriting]." None of the other specimens bears the type number.

Genus **Haemagogus** Williston

Aedes affirmatus Dyar and Knab, Proc. Biol. Soc. Washington **19:** 164. 1906.

The four original specimens, all females, are in the collection bearing identical U.S.N.M. type labels. The specimen from Salina Cruz, Oaxaca, Mexico, bears the determination label "Aedes affirmatus D. & K. Type" in Dyar's handwriting. Later Dyar (1921:103) restricted the type to this locality, thereby fixing this specimen as lectotype.

Haemagogus anastasionis Dyar, Ins. Insc. Mens. **9:** 155. 1921.

This species was described from two males and six females from Puntarenas, Costa Rica. These eight specimens are in the collection, bearing identical red U.S.N.M. type labels. One male bears the number 1529 and the determination label in Dyar's handwriting "Haemagogus anastasio [sic] Type." The number refers to the slide of the genitalia on which the specific name is spelled in the same way. This specimen is here designated lectotype. It should be noted that this species has been frequently misspelled "*anastationis*" in the literature.

Haemagogus andinus Osorno-Mesa, Proc. Ent. Soc. Washington **46:** 170. 1944.

The holotype is a male bearing the original data with the genitalia dissected and mounted on a slide. The collection also contains the allotype with its larval skin on a slide, 11 adult paratypes and 16 topotypic larvae or larval skins.

Haemagogus argyromeris Dyar and Ludlow, Military Surgeon **48:** 679. 1921.

This species was described from eight males taken at Corozal, C. Z., October 27, 1920, four being deposited in the U. S. National Museum and four in the Army Medical Museum. The four National Museum specimens are still in the collection, all bearing red U.S.N.M. type labels. One, with a slide-mounted preparation of the genitalia (no. 1456) is here designated as lectotype. Two of the syntypes are in poor condition.

Haemagogus boshelli Osorno-Mesa, Proc. Ent. Soc. Washington **46:** 165. 1944.

The holotype is a male bearing the original data with the genitalia dissected and mounted on a slide. In addition, the collection contains an allotype, 10 adult paratypes, and 5 topotypic larvae or larval skins.

Haemogogus celeste Dyar and Nunez Tovar, Ins. Insc. Mens. **14:** 152. 1927.

This species was described from two males, Maracay, Venezuela, November 11 and 15, 1926. The two specimens were found in the collection bearing the original data and Nunez Tovar numbers, but no type labels. We have selected the specimen bearing the labels "2270/Maracay Aragua, Venez. XI.11.26 / Nunez Tovar Coll. / No. 3" as the lectotype. This has the genitalia on slide No. 2770. A mounted pupal skin also bears the number 2270, although the date on this slide is given as "5-11-926."

Haemagogus chalcospilans Dyar, Ins. Insc. Mens. **9:** 110. 1921.

The type is a male with the abdomen on a slide. It bears the labels "247/Caldera I., Porto Bello Bay, Panama/March 27, 08/A. H. Jenn-

ings Coll./Type No. 24334, U.S.N.M./Haemagogus chalcospilans Dyar Type [Dyar's handwriting]." The genitalia are on slide No. 1481. The three paratypes listed by Dyar are in the collection so labeled.

Haemagogus spegazzinii falco Kumm, Osorno-Mesa and Boshell-Manrique, Amer. Journ. Hyg. **43:** 25. 1946.

The authors of this subspecies give no formal description but scatter the characters through several tables and keys, and give one character of the male genitalia for separating it from typical *spegazzinii*. They, "suggest that the type locality for *H. spegazzinii* subspecies *falco* should be the forest known as Volcanes in the valley of the Pitas River, municipality of Caparrapí, Department of Cundinamarca, Colombia. Specimens from this area have been deposited in the United States National Museum." In the collection are two pinned adults and 18 larval skins from this suggested type locality. One of the adults is a male with genitalia missing, the other a female. The larval skins are not associated with adults in the collection. Since the subspecies is based on a male genitalic character it does not seem advisable to select a lectotype from the material before us.

Haemagogus gladiator Dyar, Ins. Insc. Mens. **9:** 108. 1921.

The type and paratype are in the collection with red U.S.N.M. labels. The type male has the abdomen mounted on slide no. 1488. The fragmentary larval skin and the pupal skin of the paratype (Jennings no. 39.3) are mounted on a slide.

Haemagogus iridicolor Dyar, Ins. Insc. Mens. **9:** 106. 1921.

This species was originally described from two male types and eight male and seven female paratypes. All these are in the collection with corresponding red U.S.N.M. labels. Komp (1955) has selected the male with the genitalia slide no. 1468 as lectotype. This also bears Dyar's handwritten determination and type label.

Haemagogus janthinomys Dyar, Ins. Insc. Mens. **9:** 112. 1921.

This species was originally described from two male types and four male and three female paratypes. These are in the collection with corresponding red labels. One of the two specimens labeled "Type" also bears the number 17-1 and the slide number 219. The number 17-1 refers to the larval skin which is mounted on a slide, and no. 219 to the slide of the male genitalia. We have selected this specimen as lectotype.

Stegoconops lucifer Howard, Dyar, and Knab, Mosquitoes of North and Central America and the West Indies **2:** pl. 23, fig. 164. 1913.

Although the date on the title page of volume 2 of this work is 1912, a copy before us has stamped in it, "Copies of this book were first issued Feb. 24, 1913." The name *Stegoconops lucifer* is first associated with a figure in this volume with no other description. Dyar (1921:107) fixed the type as "a specimen from Tabernilla, Canal Zone, Panama (A. H. Jennings, breeding number 299)." This specimen is in the collection bearing slide label 309 and the label "lucifer H. D. & K. Type" in Dyar's handwriting, and can be considered the lectotype selected by Dyar. The slide was also labeled "Type" by Dyar.

Haemagogus mesodentatus Komp and Kumm, Proc. Ent. Soc. Washington **40:** 253. 1938.

The adult type material of this species was never received at the National Museum and Mr. Komp tells us that the slide of the male genitalia of the type was destroyed in transit from Panamá. There are no topotypic adults in the collection but there are 11 larval skins mounted on slides. Ten are from San José, Costa Rica (nos. 206 and 207) and one is from Parque Bolívar, San José, Costa Rica. The latter is labeled as a male, and may be the larval skin of the type, but this is not certain.

Haemagogus (*Stegoconops*) *panarchys* Dyar, Ins. Insc. Mens. **9:** 104. 1922.

The type series is as given in the original description, the holotype being specimen no. 70, a male with most of the abdomen mounted on slide no. 1466. The specimen is in poor condition, lacking all but one wing and one leg.

Aedes philosophicus Dyar and Knab, Journ. New York Ent. Soc. **14:** 190, 195. 1906.

Dyar (1921:103) restricted the type of this species as follows: "The type locality of *philosophicus* may be restricted to Tehuantepec, Oaxaca, Mexico, Knab's breeding number 295, the type being a male, figured in the monograph,

plate 23, figure 162." The collection contains a specimen with the following labels: "No. 295b See F. Knab's Entom. notes/Tehuantepec, Oax. Mex./See slide No. 330/Type No. Restrict U.S.N.M. Dyar 1921 [red]/philosoph." Slide No. 330 is labeled "philosophicus D. & K. Type." The original description is of the larva alone, but the only immature material of this type series under no. 295b consists of 1 fragmentary larval skin and 6 pupal skins. These have been mounted on a slide. All 6 adults from these pupae are in the collection, 5 males and 1 female. Since only the larva was originally described, one must consider the fragmentary larval skin under no. 295b as the lectotype. Under Knab's number 295 this was the only larva collected, all the other collections being pupae from which adults were reared.

Haemagogus regalis Dyar and Knab, Proc. Biol. Soc. Washington **19:** 167. 1906.

Of the original 22 specimens, 17 are now in the collection. Only one of these bears the red U.S.N.M. label and we consider it the holotype. It also bears the labels "No. 330v See F. Knab's Entom. notes/Sonsonate, Salv./Slide 36.I.8b/ Haemagogus regalis D. & K. Type [Dyar's handwriting]." It is a male with the genitalia mounted on a slide and the pupal skin and fragmentary larval skin on another slide.

Haemagogus uriartei Shannon and Del Ponte, Rev. Inst. Bact. **5:** 68. 1927.

The collection contains a male bearing the labels "Ins. Bac. Ent. nota 128-3/Vipos, Tuc. 4.II.27/2353/Type No. U.S.N.M. [red]/Haemagogus uriartei Snn & D P [Shannon's handwriting]." The original reference gives "Distribución: Tucumán (Vipos, 22.3.27; Shannon y Del Ponte, localidad del tipo." Since the authors refer to one male reared from a larva collected in Vipos, the difference between the published date and the date on the label may be due to the difference in times of collection of the larva and emergence of the adult. The genitalia are mounted on slide No. 2353 and what is probably the pupal skin of the type on a slide labeled "Pupa V3 Vipos 4.II.27 Haemago." There is also a female (Raco, 13.2.27) from the original series in the collection. We consider the male to be the holotype.

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ENTOMOLOGY.—*New apterous Aradidae from Puerto Rico (Hemiptera).*

CARL J. DRAKE, Iowa State College, and J. MALDONADO-CAPRILES, University of Puerto Rico.

(Received May 27, 1955)

Very little is known relative to the aradid fauna of Puerto Rico. Barber (1939, pp. 329–330) recorded two genera, each represented by a single species, from the island. These species were *Mezira abdominalis* (Stål) from Mayagüez and Hispaniola and *Aneurus minutus* Bergroth from Adjuntas. Fifteen years later, Harris and Drake (1944, pp. 130–131) described a new genus and new species of an apterous aradid as *Eretmocoris tatei* from a male specimen taken at Lares.

The present paper contains data on three genera and four species of Aradidae, including the characterization of one new genus and two new species of apterous aradids. As adults are needed for their identification, the records do not include these two genera, each represented by nymphal stages, taken in forest litter near Mayagüez by means of a Berlese funnel. The two forms heretofore listed in the literature are as follows: *Aneurus minutus* Bergroth, two adults and one last instar nymph, found under loose bark of a tree, Yauco, March 5, 1955; and *Eretmocoris tatei* Harris and Drake, Mayagüez, March 5, 1955, taken by means of a Berlese funnel from forest litter on the

ground. Field records for the new species are given under their respective descriptions. The types of the new species are in the Drake Collection, paratypes in the collections of both authors.

In order to facilitate future work and to clarify generic characters, the following genotypes of described species have been illustrated: *Eretmocoris tatei* Harris and Drake, type (male); *Acaricoris ignotus* Harris and Drake, type (female); *Glyptocoris sejunctus* Harris and Drake, type (male); *Asterocoris australis* Drake and Harris, type (male); and *Allelocoris dryadis* Drake and Harris, type (male), all illustrated by Mrs. Margaret Poor Hurd. The figures of the two new species described below were made by J. Maldonado-Capriles.

Eretmocoris disparis, n. sp.

Apterous, obovate, widest behind middle of abdomen, considerably narrowed anteriorly, very little narrowed behind, reddish to blackish fuscous, prominently sculptured; mesonotum at middle fused with metanotum; metanotum fused with first two abdominal tergites, the rest of abdominal tergite (save seventh, but not connexiva) fused. Abdominal stigmata all lateral. Female broader than male. Length, 3.20–3.50 mm; width, 1.30–1.70 mm.

Head longer on median line than width across eyes (54:46), obliquely narrowed behind eyes, with fairly large neck, with prominent median longitudinal ridge, furrowed on each side of ridge; tylus convexly longitudinally raised, prominent;

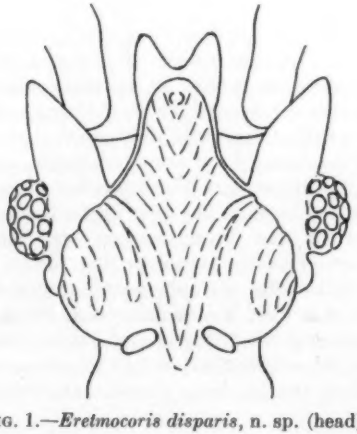

FIG. 1.—*Eretmocoris disparis*, n. sp. (head).

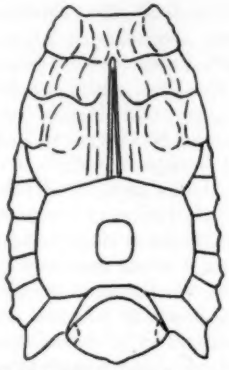

FIG. 2.—*Eretmocoris disparis*, n. sp. (body, dorsal aspect).

juga a little longer than tylus, the parts surpassing tylus divergent, rounded, with blunt tips. Antenniferous tubercles quite large, divergent, conelike. Antennae rather short, twice as long as head (94:46), finely granulate, each minute granule beset with a short, inconspicuous, fine hair, basal segment much thicker and much longer than others, measurements—I, 32; II, 18; III, 22; IV, 22. Rostrum dark fuscous, not quite attaining apex of sulcus; sulcus broad, deep, not extending to base of head.

Pronotum wider at base than width across eyes (75:46), only a little wider in front (52:46); mesonotum wider than pronotum, subequal in length, fused at middle with metanotum; metanotum fused with first two abdominal tergites, the triangular median part of both mesonotum and metanotum longitudinally carinate, the median carina longer and slightly more elevated than lateral ones, the latter convergent anteriorly. Metasternal orifice visible from lateral aspect. Legs rather short, plain, fuscous to dark fuscous. Abdomen with the fused dorsal tergites almost quadrate in outline, with a definite pattern of impressions and ridges, the glandular area prominent; seventh tergite not fused, similar to *E. tatei* in shape. Abdomen above without hairs, with all spiracles visible from above. Legs dark brownish to dark fuscous, inconspicuously pubescent.

Type (male) and *allotype* (female), Mayagüez, Puerto Rico, March 1955, collected by means of a Berlese funnel from ground litter in forest. *Paratypes*: 4 specimens, taken with type. Also 4 or 5 nymphs of *E. disparis* and nymphs of two alate species of aradids were found in the same batch of litter.

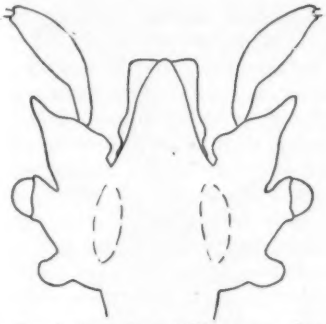

FIG. 3.—*Aglaocoris natalii*, m. sp. (head).

Differs from *E. tatei* Harris and Drake by form of body (slowly roundly narrowed anteriorly; pronotum narrower than tergite VII), and the appendages inconspicuously pubescent. In *tatei* (Fig. 1), the body is obovate and the appendages distinctly beset with short, pale, setal pubescence. The two species are not readily confused.

Aglaocoris, n. gen.

Apterous, oblong, broad, with dorsal surface coarsely punctate, irregularly rugulose, the abdomen with regular patterns of impressions and ridges. Head subquadrate, juga and tylus subequal in length; eyes small, distinctly stylate, each placed on the outer end of a lateral pedicel; each side of head with a postocular tubercle placed about half way between an eye and the neck. Collar distinct, short and rather narrow. Antenniferous tubercles large, divergent, terminating anteriorly in a fingerlike projection. Antennae rather short, fairly slender, indistinctly pubescent; segment I stout, slightly bent, extending more than half its length beyond apex of juga, much longer and much stouter than other segments; segments II and IV subequal in length, III slenderest, slightly shorter (subequal, including nodular segment). Legs rather short, plain. Abdomen convex beneath. Pronotum much wider than head across eyes, not fused, free; mesonotum a little wider than pronotum, also feebly extended laterally but not lobate, partly fused at middle with metanotum; metanotum fused behind with first tergite (judging from last instar nymph, also second tergite); abdomen with tergites III to VI fused into a quadrate area, with dorsal glandular organ prominent; seventh tergite not fused; connexiva fairly wide, with segments IV to VII distinct, the anterior segments fused. Stigmata on VI, VII and VIII (genital segment) lateral, V sublateral (partly visible from above), and II, III and IV a little removed from outer edge and thus not visible from dorsal aspect (each more progressively removed anteriorly). Spiracles VII and VIII placed on small projections.

Genotype, *Aglaocoris natalii*, n. sp.

Two other American genera of apterous Aradidae have the eyes pedicellate—*Asterocoris* Drake and Harris and *Allelocoris* Drake and Harris. *Aglaocoris* may be distinguished from both of these genera by the much shorter legs and antennae (antennal segment I much longer than any other), tylus and gula subequal in length, body without lateral lobes or fingerlike projections, head with postocular tubercle on each side, metanotum fused with first two abdominal tergites, the rest of tergites (except VII) fused together, and the position of abdominal spiracles.

Aglaocoris natalii, n. sp.

Large, broad, blackish ferrugineous, without vestiture on dorsal surface; legs beset with short, pale, setal hairs; antennae with short, pale, pubescent hairs, the pubescence slightly longer and more setose on first segments. Length, 5.50–6.10 mm; width, 2.70–3.00 mm. Female wider than male.

Head slightly wider across eyes than median

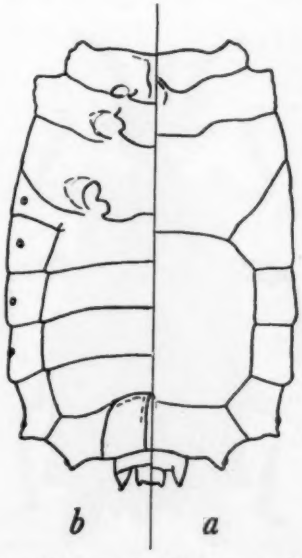

FIG. 4.—*Aglaocoris natalii*, n. sp. (*a*, dorsal; *b*, ventral).

FIG. 5.—*Eretmocoris tatei* Harris and Drake (type).

length (115:110); ocular pedicel moderately large, the eyes fairly prominent; postocular pedicel shorter, knoblike, not as thick, placed about midway between an eye and neck, more densely setose than other parts of head. Antennae rather short; segment I much stouter and longer than others, III thinnest and practically as long as II (including modular segment); measurements—I, 48; II, 29; III, 28; IV, 30. Rostrum stout, ferrugineous, almost as long as channel; mandibular and labial stylets (when fully extended) reaching almost to end of abdomen.

Pronotum short, much wider than head across eyes (105:150); mesonotum slightly wider than pronotum, with outer margins slightly extended, with a large median carina, partly fused with metanotum; metanotum fused with first two abdominal tergite, the rest of abdominal tergites (save seventh) fused into a subquadrate area.

FIG. 7.—*Acaricoris ignotus* Harris and Drake (type).

FIG. 6.—*Allelocoris dryadis* Drake and Harris (type).

Connexiva segmented, the anterior three fused. Entire dorsal surface coarsely punctate, the venter with smaller punctures; abdominal tergites with a definite pattern and arrangement of impression and ridges; stigmata of seventh and eighth segments placed on small projections, the seventh segment with a prominent, smooth, subconelike projection beneath each projection bearing a spiracle. In all comparative measurement, 80 units equal one millimeter.

Type ♂ (male) and *allotype* (female), Yauco, Puerto Rico, under loose bark of a tree, March, 1955, collected by Antonio Natali, after whom the insect is named. *Paratypes*: 60 specimens,

FIG. 8.—*Asterocoris australis* Drake and Harris (type).

taken with type, and from Mayagüez, April 1955, also under loose bark of a dead tree. Some large nymphs were also taken with the adults.

An examination of last instar nymphs indicates that the metanotum is fused with both first and second abdominal tergites. The first two basal ventrites are also fused. The other two species of apteous aradids found in Puerto Rico (*E. tatei* and *E. disparis*) are much smaller, eyes not stalked, and all spiracles are lateral. The discussion under the generic description distinguishes *A. natalii* from the South American apterous aradids having pedicellate eyes.

FIG. 9.—*Glyptocoris sejunctus* Harris and Drake (type).

GENERA AND SPECIES OF AMERICAN APTEROUS ARADIDAE

The following checklist enumerates the genera and specis of apterous aradids listed in the literature. It should be noted that *Acaricoris brasiliensis* Wygodzinsky (1948), *A. teresonolitana* Wygodzinsky (1948) and *Emydocoris usingeri* Wygodzinsky (1948) have been transferred recently by Kormilev (1953) to the genus *Pictinus* Stål.

Family ARADIDAE Costa, 1843

Subfamily MEZIRINAE Oshanin, 1908

Tribe CARVENTINI Usinger, 1941

Genus ACARICORIS Harris and Drake, 1944

Type, *Acaricoris ignotus* Harris and Drake

1. **ignotus** Harris and Drake, 1944: United States (La., Miss., Ga.).

   Genus AGLAOCORIS Drake and Maldonado, 1955

   Type, *Aglaocoris natalii* Drake and Maldonado
2. **natalii** Drake and Maldonado, 1955: Puerto Rico.

   Genus ALLELOCORIS Drake and Harris, 1944

   Type, *Allelocoris dryadis* Drake and Harris
3. *dryadis* Drake and Harris, 1944: Brazil.

   Genus ASTEROCORIS Drake and Harris, 1944

   Type, *Asterocoris australis* Drake and Harris
4. **australis** Drake and Harris, 1944: Brazil.
5. **schubarti** Wygodzinsky, 1948: Brazil.

   Genus DIHOBGASTER Kormilev, 1953

   Type, *Dihybogaster incrustatus* Kormilev
6. **incrustatus** Kormilev, 1953: Brazil.

   Genus EMYDOCORIS Usinger, 1941

   Type, *Emydocoris testudinatus* Usinger
7. **testudinatus** Usinger, 1941: Brazil.

   Genus ERETMOCORIS Harris and Drake, 1944

   Type, *Eretmocoris tatei* Harris and Drake
8. **disparis** Drake and Maldonado, 1955: Puerto Rico.
9. **tatei** Harris and Drake, 1944: Puerto Rico.

   Genus GLYPTOCORIS Harris and Drake, 1944

   Type, *Glyptocoris sejunctus* Harris and Drake
10. **annulatus** Kormilev, 1953: Brazil.
11. **confusus** Kormilev, 1953: Brazil.
12. **espiritosantensis** Wygodzinsky, 1948: Brazil.
13. **fluminensis** Wygodzinsky, 1948: Brazil.
14. **milleri** Wygodzinsky, 1948: Brazil.
15. **plaumanni** Kormilev, 1954: Brazil.

16. **sejunctus** Harris and Drake, 1944: Brazil.
Genus NOTOPLOCORIS Usinger, 1941
Type, *Notoplocoris montei* Usinger
17. **mendesi** Wygodzinsky, 1948: Brazil.
18. **montei** Usinger, 1941: Brazil.
19. **potensis** Drake and Harris, 1944: Brazil.
20. **sobrali** Wygodzinsky, 1948: Brazil.
Tribe MEZIRINI Usinger, 1941
Genus PICTINUS Stål, 1873
Type, *Pictinus cinctipes*, Stål
21. **brasiliensis** (Wygodzinsky), 1948: Brazil.
22. **dureti** (Kormilev), 1953: Argentina.
23. **intermedius** (Kormilev), 1953: Brazil.
24. **montrouzieri** Kormilev, 1953: Brazil.
25. **plaumanni** Kormilev, 1953: Brazil.
26. **teresopolitanus** (Wygodzinsky), 1948: Brazil.
27. **usingeri** (Wygodzinsky), 1948: Brazil.

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ZOOLOGY.—*Remarkably preserved fossil sea-pens and their Recent counterparts*

FREDERICK M. BAYER, U. S. National Museum.

(Received May 23, 1955)

The material to be described below, including as it does specimens of Recent and Tertiary pennatulaceans showing close morphological similarity, is indeed remarkable. It is even more so in view of the fact that the sea-pens in question are soft-bodied creatures that do not lend themselves to fossilization. The Recent material, four lots containing in all seven specimens, was collected in the Gulf of Mexico by the vessels *Albatross*, *Grampus*, and *Pelican*, and by C. T. Reed. The interesting suite of fossils from the Tertiary of Trinidad, collected by Dr. H. G. Kugler of Pointe-à-Pierre, was submitted to me for study by Dr. W. P. Woodring of the U. S. Geological Survey. Photographs of some of the specimens had earlier been sent by Dr. Kugler to Dr. Fred B. Phleger, who suggested that they might represent molds of some pennatulacean. This suggestion, passed along to Dr. Woodring, resulted in my seeing the photographs and, eventually, the specimens themselves. Subsequently, Dr. Kugler visited the Basel (Switzerland) Museum and arranged for similar fossils housed in that institution to be sent to me for consideration with the material from Trinidad. The specimens from the Basel Museum were collected in the Kei Islands, from a stratum of undertermined age.

I am greatly indebted to Dr. Woodring for the opportunity of seeing the fossil material and for arranging its transmittal to me. Needless to say, this study could not have been made but for the kindness of Dr. Kugler, collector of the Trinidad specimens. Dr. G. Arthur Cooper, curator of the Division of Invertebrate Paleontology, U. S. National Museum, made the excellent photographs reproduced on Fig. 2, for which I express sincere thanks. In the preparation of the specimens for study I have been greatly assisted by M. L. Peterson, Jr., of Arlington, Va., who has done the necessary cutting.

Except for *Cancellophycus* from the Lias, Jurassic and Cretaceous, as reported by Lucas (1938, 1940), pennatulacean octocorals are known in the fossil state only by their calcareous axes. Several genera have been erected for these fossils, and at least one "species" has been assigned to the Recent genus *Pavonaria* (=*Balticina*). It is,

of course, difficult, if not impossible, to base specific determinations of sea-pens upon characters of the axial rod alone. Therefore, it is of no small interest to discover remains of pennatulaceans referable to a modern genus by virtue of the remarkable preservation of the external gross morphology of nearly entire colonies. This was accomplished by the infilling of molds in soft mud by a coarser material. It is necessary to assume that the specimens were dislodged from their living positions and strewn over a mud bottom in which they left impressions that became filled with sand. Artificial fossils of very similar appearance were made by taking rubber casts from plaster molds of Recent specimens; two of these are shown on Fig. 2, *d* and *e*, made from the specimens bearing catalogue numbers 49758 and 43023 described below.

Several of the fossils were sectioned but none show any indication of the calcareous axial rod, so it must be concluded either that the axial rods were swept away from the area after decomposition of the soft parts, that conditions during the infilling of the molds were sufficiently acid to have dissolved away the axes, or that the entire animals were somehow transported away from the molds.

Although even generic determinations of Pennatulacea depend upon spicular, calycinal and zooidal characters none of which are preserved in the fossils, enough can be seen of the colonial morphology of the casts here described to warrant assigning them to the genus *Virgularia*. In this genus, the auto-zooids are fused into leaf-like outgrowths arranged biserially along most of the stem (rhachis); these polyp-leaves do not quite meet along one side of the rhachis and thus leave open what is usually called the dorsal track. Along the opposite side of the rhachis the leaves may meet or even fuse, but a distinct suture line is usually detectable. Siphonozooids occur on or between the polyp-leaves and commonly also along the dorsal track. No calcareous spicules occur in the leaves, but small, corpuscle-like sclerites may sometimes be found in the rhachis and stalk. The lower part of the stem, known as the stalk (Stiel) is free of polyp-leaves and serves to anchor the colony in soft bottoms.

Differentiation of the species depends upon, among other things, the position of the siphonozooids, the number of autozooids per leaf, and the degree of fusion of the autozooids making up the leaves. These features, like all other details of the soft parts, are not preserved in the casts. There is no way to distinguish the fossil specimens from the Recent species now living in the Gulf of Mexico, so they must be assigned to the same species. This is not so radical a course as it may at first seem, inasmuch as two Recent pennatulaceans now live on both sides of the Panamanian isthmus. The Atlantic and Pacific populations of one species are looked upon as indistinguishable, and of the other as representing only forms, although they certainly have been separated since sometime in the Miocene. The species thus seem to be quite stable and presumably have undergone little change since the Tertiary.

The four lots of Recent *Virgularia* from the Gulf of Mexico have been compared with specimens of *V. mirabilis* from Kiel, and with the various descriptions of that species in the literature. They prove to be not the same. The West Indian material more closely resembles *Virgularia rumphii* and *V. abies*, both East Indian forms, but differs in detail from those species also. It is therefore necessary to establish for the specimens from the Gulf of Mexico a new species, which will include the fossil casts from Trinidad as well. This species may be known as:

Virgularia presbytes, n. sp.
Figs. 1; 2, a–e

Virgularia spec. Deichmann, 1936, p. 274.
Virgularia mirabilis Bayer, 1952, p. 189; 1954, p. 281. Not *Pennatula mirabilis* O.F. Müller, 1776.

Diagnosis.—Virgularias with thick, fleshy polyp-leaves composed of 13–30 autozooids united by the full length of their anthosteles, showing no distinct projecting calyces and without marginal tubercles; leaves in pairs fused more or less completely on the ventral side of the rhachis but well-separated on the dorsal side, leaving free a distinctly grooved dorsal track; siphonozooids in 2–7 irregular, crowded rows between the polyp-leaves, in the larger specimens extending out onto the dorsal track in an irregular longitudinal row or field on either side of the

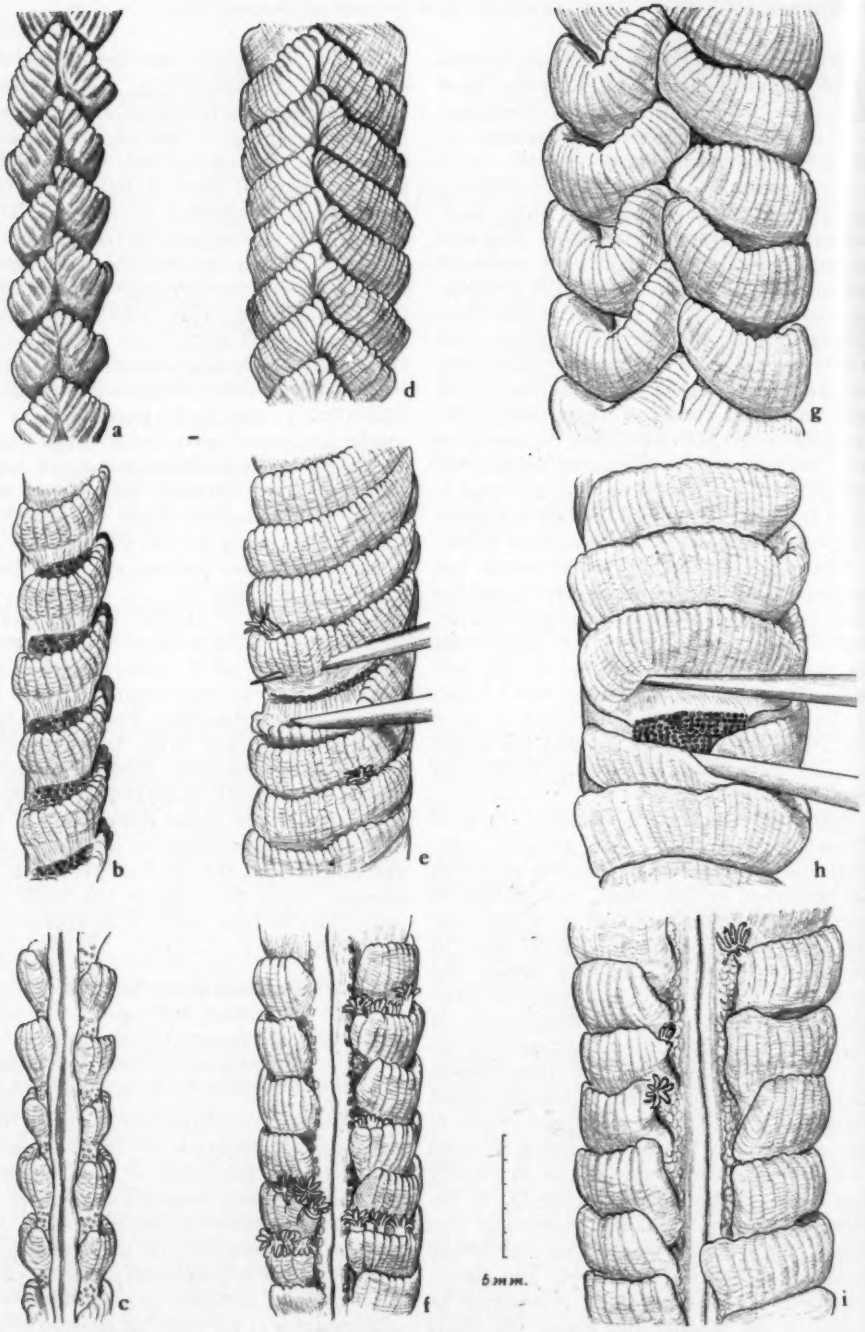

FIG. 1.—*Virgularia presbytes*, n.sp.: *a–c*, Specimen no. 49758, off Mobile, Ala. (*a*, ventral; *b*, lateral; *c*, dorsal views of rhachis); *d–f*, holotype, no. 50143, off Cape Canaveral, Fla. (*d*, ventral; *e*, lateral; *f*, dorsal views of rhachis); *g–i*, specimen no. 43023, off Galveston, Tex. (*g*, ventral; *h*, lateral; *i*, dorsal views of rhachis).

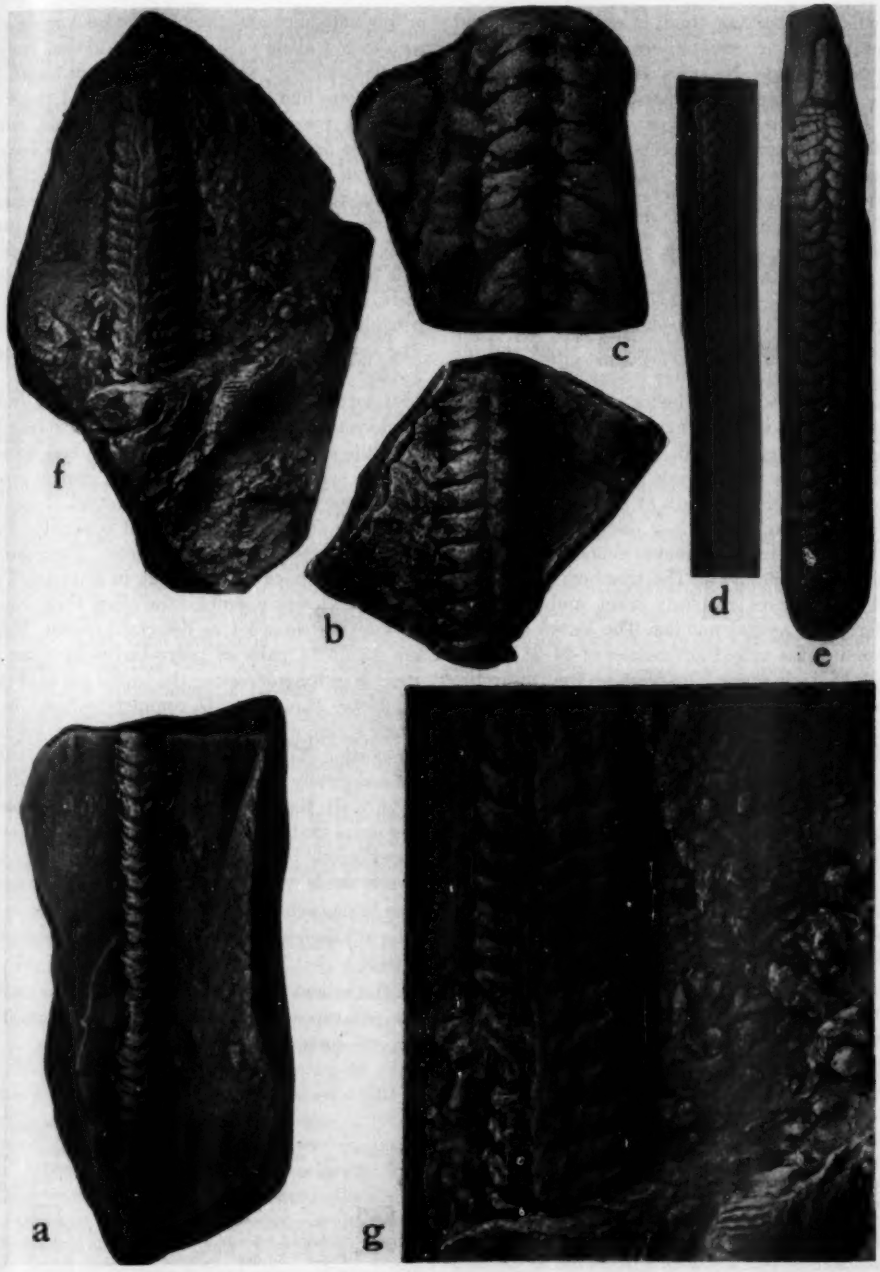

FIG. 2.—*a–e*, *Virgularia presbytes*, n.sp: *a–c*, Fossil specimens from the Pointe-à-Pierre formation of Trinidad; *d–e*, rubber casts of plaster molds made from the specimens shown in Fig. 1, *a* and *g*. *f–g*, *Pteroeides argenteum* (Ellis and Solander)?, fossil from Great Kei Island: *f*, Entire slab, reduced; *g*, part of same specimen, natural size (Basel Museum). All photographs by G. A. Cooper.

median groove. Axis stout, in cross section round toward the apex, oval or dorso-ventrally flattened toward the base. No spicules were found in either the polyp-leaves or the rhachis.

Descriptions.—The type lot, U.S.N.M. no. 49755, contains four specimens, one of which has been selected as the holotype and given the catalogue number 50143. Off Cape Canaveral, Fla., 28° 54′ N., 80° 39′ W.; 9 fathoms; *Pelican* station 171-5, January 19, 1940.

SPECIMEN A: Length 164 mm; the axis is nearly round, 2.25 × 2.50 in diameter. At the upper end of the rhachis, where the polyp-leaves diminish in size, the axis is very stout and obviously once projected far beyond the tip of the fleshy rhachis. The diameter of the rhachis with its polyp-leaves is 5–7 mm. The leaves are thick, fleshy, directed upward, obliquely placed on the rhachis, their ventral ends higher; 14 pairs occur in 3 cm of rhachis length at about the middle of the specimen. There is a distinct dorsal track with a deep median groove; none of the pairs of leaves meet across it. The members of the pairs of polyp-leaves regularly meet and are fused along the ventral midline. The leaves are composed of the united anthosteles of 24–28 autozooids in single series. There are no free, projecting calyces, and the zooidal apertures are entire. Autozooids with well-developed gonads occur in the leaves throughout the length of the rhachis. The siphonozooids occur on the rhachis in three or four rows beneath each leaf, and extend out as an irregular row along the dorsal track on each side of the midline.

SPECIMEN B: Length 159 mm.; the axial rod is incomplete at both top and bottom, and part of the rhachis and the stalk are missing below. At the distalmost part, the axis is round, 1.5 mm in diameter. The rhachis, including the polyp-leaves, is 5.0–6.5 mm in diameter. The leaves are thick and fleshy, situated as in specimen a; 12 or 13 pairs occur in 3 cm of length about the middle of the rhachis. The leaves do not overlap dorsally, and the dorsal track is distinct and grooved; ventrally the leaves of each pair meet and are fused together. The leaves are composed of 25–27 autozooids united by the full length of their anthosteles; no projecting calyces; no calycinal teeth. Well-developed gonads are observable in the autozooids of leaves at all levels except at the distal tip, where there are about six pairs of undeveloped leaves decreasing in size distad. The siphonozooids occupy all the rhachis surface between the leaves, closely packed in four or five indistinct rows; they extend out as an irregular row along each side of the dorsal track.

SPECIMEN C: A specimen 151 mm in length is incomplete, like the other specimens of the lot, which it resembles closely. The rhachis, with leaves, is 5.0–6.5 mm in diameter; 13–15 leaves appear in 3 cm of length about the middle of the rhachis; the leaves contain usually 25 autozooids in a single series. Members of the leaf-pairs partially or completely fused ventrally. Siphonozooids between the leaves in three or four irregular rows, extending out onto the rhachis to form an irregular row along each side of the dorsal track. The autozooids in the fully developed leaves are fertile.

Holotype, U.S.N.M. no. 50143, selected from the foregoing lot, is a specimen 157 mm in length, with the axis incomplete both above and below, and the stalk and lower part of the rhachis missing. At its distal end the axis is round, 2 mm in diameter; at the proximal end it is slightly flattened, 2.25 × 2.5 mm in diameter. The rhachis with its polyp-leaves is 6–7 mm in diameter. The holotype closely resembles the other three members of the same lot as described above. There are 13 or 14 pairs of polyp-leaves in 3 cm of rhachis in the midregion; the leaves are made up of 24 or 25 autozooids completely fused in a single series, without any projecting, free calycular portion. The leaves of each pair are partially or completely fused along the ventral midline (Fig. 1, d); the dorsal track is distinct and shows the usual median groove (Fig. 1, f); the siphonozooids occur in 2–4 indistinct, crowded rows between the leaves (Fig. 1, e), and in an irregular row along each side of the dorsal track (Fig. 1, f). The autozooids of the fully developed leaves are fertile.

The salient characters of the holotype and of the paratypes from the same and other localities may be summarized in tabular form:

Specimen Cat No.	Diameter of rhachis	Diameter of axis	Number of autozooids per leaf	Number of leaves in 3 cm.	No. of rows of siphonozooids between leaves	No. of rows of siphonozooids on dorsal track
49758	3.5–4.5	1.5–2.25	13–15	10–15	3–4	0
43214	5–6	1.5–2	24–25	13–21	2–4	0
49755(a)	5–7	2.25–2.5	24–28	14	3–4	1
(b)	5–6.5	1.5	25–27	12–13	4–5	1
(c)	6–7	2–2.25	24–25	13–14	2–4	1
50143	5–6.5	2–2.25	25	13–15	3–4	1
43023	10	3–4	30	9–10	6–7	2–3

Localities.—Holotype and three paratypes (U.S.N.M. no. 50143; 49755) from *Pelican* station 171-5; off Cape Canaveral, Fla., 28° 54′ N., 80° 39′ W., 9 fathoms; January 19, 1940.

Paratypes as follows:

U.S.N.M. no 43023. *Grampus* station 10470; off Galveston, Tex., 29° 03′ N., 94° 26′ W., 9 fathoms; February 28, 1917.

U.S.N.M. no 43214. Near Corpus Christi, Tex. C.T.Reed.

U.S.N.M. no. 49758. *Albatross* station 2387; off Mobile, Ala., 29° 24′ N., 88° 04′ W., 32 fathoms; March 4, 1885.

Remarks.—Although there is some diversity, especially in size and stoutness, among the specimens examined, it is impossible to separate them on any scientific grounds into species conforming with the three size groups represented.

All the specimens agree in: (1) the thick, strongly adherent, closely placed polyp-leaves made up of completely fused autozooids; (2) the absence of any free calycular part of autozooids; (3) the absence of any teeth or tubercles around the autozooid apertures; (4) the multiple rows of siphonozooids between the polyp-leaves; and (5) the very stout, rigid axial rods.

There is variation, often between specimens of very similar appearance, in (1) the number of rows of siphonozooids between the leaves; (2) the number of siphonozooids extending out onto the dorsal track; and (3) the relative stoutness of the axis.

It seems preferable to retain all of the specimens under a single species, at least until enough material becomes available to permit a re-evaluation of characters.

The specimen from Corpus Christi was briefly mentioned by Miss Deichmann (1936, p. 274), who noted a similarity with *Virgularia schultzei*. That species, however, has its siphonozooids on the polyp-leaves, unlike the present material.

In some respects, *Virgularia presbytes* resembles *V. abies* (Kölliker) from Japan. The latter has a larger number of autozooids (40) in the leaves, which have sinuous margins, a single row of siphonozooids between the leaves, and a double row on either side of the dorsal track. The species must therefore be considered distinct.

Fossil specimens.—The specimens are all three dimensional sandstone casts of molds in silt or silty shale. They have previously been determined as the tracks of mollusks and called "bilobites" or "Palaeobullias." The manner in which individuals may lie one upon another precludes their being the trails of any organism, and their great similarity in form to certain sea-pens suggests that in reality they are casts of those animals. The fact that a Recent pennatulid now living in the Gulf of Mexico can be distinguished by no known scientific means from the casts from Trinidad lends further support to this view.

Although the three dimensional preservation of a soft-bodied organism may seem remarkable, it is surely no more so than the preservation of a molluscan trail in the mud. Pennatulaceans live on muddy substrates in which they are anchored by the fleshy, often bulblike, lower end of the stalk. The colony stands erect, with the polypiferous portion projecting from the mud. It must be assumed that the living specimens were torn from their normal positions and strewn about over a muddy surface in which they left their impressions. Such impressions would have been very fugitive and to be preserved must have been in very quiet waters or exposed to air until filled in and covered over by the material that is now sandstone.

The general nature of the formation in which these fossils occur is pertinent to the problem of preservation, and Mr. Kugler's description of it reads as follows:

> At its type locality the Pointe-a-Pierre formation consists of about 120 feet of fine-bedded dark grey silt and silty shale with regular intercalations of cubical fracturing quartzitic sandstones and massive coarse grit up to 10 feet thick. The sandstones show graded bedding and some of the conglomeratic layers are the result of turbidity currents. Flowcasts, the infills of fine-grained sandstone in grooved silt surfaces, are frequent and so are flowage structures inside some very fine grained quartzitic sandstones. An arenaceous assemblage of foraminifera indicate muddy bottom environment during part of the Claiborn and/or Wilcox time when the Pointe-a-Pierre formation was deposited in a thickness of up to 700 feet, forming some topographically prominent features in the Central Range of Trinidad and Eastern Venezuela.
>
> The only megafossil remains found in the Pointe-a-Pierre formation are occasional "tracks" termed "Bilobites" or "Palaeobullias" in private reports. These and also some "Helminthoides" are indicative of "Flysch"-like rocks as known from the Carpathians and Alps where they represent foredeep deposits associated with advancing thrust sheets. The nature of such rocks is characterized in Trinidad by coarser grains, often silt pebbles, at the bottom of a sand layer. Upwards the coarse material is graded into a finer sandstone and finally into almost varved silt with films of fine comminuted carbonaceous matter separating the silt laminae of 1 to 2 mm. thickness.

None of the "tracks" collected was actually found in situ, but mostly amongst the block debris at the base of the cliff at Pointe-a-Pierre or along the coast where the sandstone blocks are exposed to the action of waves. However, amongst the flow casts on the bottom side of some flaggy sandstones other "tracks" were found in situ, and the same tracks were also noticed together with "Bilobites," thus rendering a co-existence most likely. All the protruding casts of tracks on the flaggy sandstone surfaces must be infills of hollows formed in the top layer of the silt below. Fig. 305, p. 368, of O. Abel's "Vorzeitliche Lebensspuren" (1935) represents conditions almost identical to those at Pointe-a-Pierre. In fact specimen K.9628 from the San Fabian Quarry in the Marie Douleur Valley east of Pointe-a-Pierre, is almost a direct proof of this assertion. When this specimen was found at the face of the quarry, it was still covered with a light grey, silty clay which in fragments is still found sticking between the "ribs" of the "Bilobites." The sand must have filled a mold in the silt and this observation was made on all the samples collected, with the exception of one where the mold of a "Bilobites" was found in a fine-grained quartzitic sandstone. This mold must have been filled with silt or a coarser sandstone that subsequently weathered and left the original mold. The grain size and material of the "Bilobites" casts are the same as that of the adjoining part of the flaggy sandstone, hence there could not be a replacement of the tissue of the original animal or plant by mineral matter. This point is stressed on account of the suggestion that "Bilobites" may actually have been a *Virgularia*-like fossil.

The specimens themselves show a wider variation in size than do the Recent individuals thus far examined. They range in width of rhachis from about 3 mm to over 25 mm. The casts are hemicylindrical, usually straight or nearly so; on either side of a median longitudinal groove or suture, which represents the dorsal track or the ventral midline of Recent colonies, there are oblique transverse grooves which cut the half-cylinder into lappets representing the polyp-leaves. On some specimens the median track is wide, distinct, and grooved, and from the orientation of the leaves obviously represents the dorsal track; on others it is narrow or remains only as a junction line of the leaves of opposite sides and thus represents the ventral midline. The smaller specimens (under 15 mm in diameter) have 8–16 pairs of leaves in 3 cm of length, while the larger ones (17–30 mm in diameter) have only 5 or 6 pairs in the same length.

Fig. 2 a–e shows the range of sizes among the fossil individuals, and compares them with casts of Recent specimens, Fig. 2 d–e. All are natural size.

Virgularia sp.

In the collection of the Basel Museum is a large sandstone slab measuring about 26 x 22 cm, from Great Kei Island, which is crossed by a cast of what appears to be a large *Virgularia*. The width of the cast itself is about 20 mm; there are approximately 35 pairs of obliquely placed lappets roughly 1 cm apart; they converge proximad, indicating that it is the dorsal aspect of the colony that is exposed. Although the general configuration of the cast indicates a *Virgularia*, it is not at present possible to assign it to any of the known species.

Horizon.—Eocene or Oligocene?

Locality.—Near the village of Ohowait, east coast of the middle part of Great Kei Island, south eastern Moluccas. F. Weber, 1926. Basel Museum.

Pteroeides argenteum (Ellis and Solander, 1786)? Fig. 2, f–g

A smaller slab from Great Kei shows a cast probably represents a different pennatulid. From the jagged edges of the lappets, one concludes that the species was one with a stong armature of spicules in the polyp-leaves. In size and apparent proportions it agrees reasonably well with Ellis and Solander's *Pennatula argentea*, a Recent species of she East Indies, that has such armature.

The photographs, Fig. 2, f and g, show the entire slab, reduced, and a detail, natural size. It can be seen from Fig. 2, f, by the way several individuals lie on top of one another, that these are the casts of solid objects and not of trails in the mud.

Horizon and locality.—Same as for the foregoing. Basel Museum.

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